NATURE

No. 4205 SATURDAY, JUNE 3, 1950 Vol. 165

CONTENTS

	Page
Family Limitation and Human Fertility in Britain	863
Further Views on Plant Evolution. By Prof. Ronald Good	864
Some Problems in Natural Philosophy. By Sir Edmund Whittaker, F.R.S.	865
A Pedologist's Perspective. By Dr. D. A. Osmond	866
Earthquake Geography. By Ernest Tillotson	867
The National Institute for Research in Dairying. By Prof. H. D. Kay, C.B.E., F.R.S.	869
Production and Application of High-intensity X-Ray Beams. By Dr. D. P. Riley	870
Correlation of Electrophoretic Studies and Other Factors in the Syndrome of Secondary Shock. By Prof. Dan H. Moore and Dr. C. L. Fox	872
Obituaries:	
Prof. F. W. Twort, F.R.S.	874
Prof. R. A. S. Macalister. By Dr. Glyn E. Daniel	874
News and Views	875
Developments in Meteorology: Centenary Celebrations of the Royal Meteorological Society. By Sir David Brunt, F.R.S.	879
Metabolic Interrelations. By R. Pearcy	880
Wattle Research Institute, South Africa	881
Effect of Vernalization and Photoperiodic Treatments on Growth and Development of Wheat. By Dr. J. J. Chinoy	882
Serological Behaviour of Human and Hog *H*-Substances with the so-called Anti-*O* Sera of Different Origin. By E. F. Annison and Dr. W. T. J. Morgan, F.R.S.	884
Welfare of Animals in the Laboratory. By Dr. G. Lapage	885
Carnegie Trust for the Universities of Scotland: Annual Report for 1948-49	886
John Hanson: a Maker of Microscope Slides. By H. Gwynedd Green	887
Letters to the Editors:	
Deuteron Reactions with Separated Neon Isotopes.—J. Ambrosen and K. Marck Bisgaard	888
Application of Proportional Scintillation γ-Ray Counters to the Determination of Radioactive Decay Schemes.—Dr. Patrick E. Cavanagh	889
Ultra-Violet Band-Systems of CF.—E. B. Andrews and Dr. R. F. Barrow	890
Production of an Irreversible Joshi Effect in the Hysteresis-Range below the Threshold Potential.—B. R. Marathe and S. S. Bommannavar	890
Effect of Mercury on the Thermo-Electric Properties of Selenium.—H. K. Henisch and M. François	891
Detection and Estimation of Small Amounts of Impurities in the Air.—G. Phillips	892
Mapping Chromosome Centromeres by the Analysis of Unordered Tetrads.—H. L. K. Whitehouse	893
South African Fossil Hominoids.—Prof. W. E. Le Gros Clark, F.R.S.	893
Accessory Isochromosomes in the Moss *Dicranum majus*.—Antero Vaarama	894
Effect of Sodium Ribose Nucleate on Meiosis of Grasshoppers.—Y. Ojima and M. Ogaki	895
Action of Cyanate on the Bone Marrow of Rats.—R. F. A. Dean and F. W. Gunz	895
Physiological Variations in Serum Proteins in Cattle.—R. J. Garner	896
Association of Xylan with α-Cellulose in Jute.—P. B. Sarkar, A. K. Mazumdar and K. B. Pal	897
Influence of Sugars and Amines on the Colorimetric Hexosamine Method of Elson and Morgan and its Possible Elimination.—J. Immers and E. Vasseur	898
2.3- and 2.5-Dihydrothiophenes.—S. F. Birch and D. T. McAllan	899
Details of Wind Structure Revealed by Artificial Nucleation of Supercooled Clouds.—Dr. Ronald Frith	899
Breaking of Diapause in the Winter Egg of the European Red Spider.—Miss G. F. E. M. Dierick	900
Copper-Deficiency Disease of Apple Trees.—Prof. A. E. Muskett	900
Soil and Vegetation in British Somaliland.—P. E. Glover	901

Editorial and Publishing Offices of "NATURE"
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.
Telephone Number: Whitehall 8831
Telegrams: Phusis Lesquare London
Advertisements only should be addressed to:
T. G. Scott & Son, Ltd., Talbot House, 9 Arundel Street, London, W.C.2
Telephone Number: Temple Bar 1942
The annual subscription rate is £4 10 0, payable in advance, inland or Abroad

All rights reserved. Registered as a Newspaper at the General Post Office

FAMILY LIMITATION AND HUMAN FERTILITY IN BRITAIN

THE subject of population growth or decline has been in the forefront since the Royal Commission on Population began its investigations and deliberations in 1944. Last year its final report was published, and one of its main conclusions was that the slackening of population growth was due to a change in respect of average family size. The Royal Commission outlined the historical background against which the small family came into being: the decline in the importance of the family as a productive unit, the lengthening period during which children remained dependent upon their parents, the advantages of small family size for those struggling for social security and promotion, the increasing and more widely spread knowledge of the techniques of controlled fertility, the changing status of women and the increased opportunities for the enjoyment of leisure outside the home.

Most of these factors which are thought to have caused such a momentous change in the family habits of the British people in the latter part of the nineteenth century cannot now be investigated; but certain specific investigations were instigated by the Commission for the complete performance of its task, and one of these was an inquiry concerning the causes and effects of birth control. The Commission sought the help of the Royal College of Obstetricians and Gynæcologists in a large-scale inquiry of a kind never before undertaken in Britain, and the results are published under the title "Family Limitation and its Influence on Human Fertility during the Past Fifty Years"*. A questionnaire, the outcome of much consideration and experiment, sought information in four main categories: particulars concerning the history and social background of the respondent; a detailed reproductive history, including the length, date and outcome of every pregnancy; general questions on the use of birth control and the planning of the family; and detailed questions on the use of the various methods of birth control. The director of this inquiry and the author of the report, Dr. E. Lewis-Faning, statistician to the Department of Preventive Medicine, Welsh National School of Medicine, in his presentation of the material shows that he is fully aware of the difficulties of his task and of the inevitable defects in his statistics. It can be said, however, that no one could be more conscious of these defects than the author himself, and that he has made the best possible use of the available material.

The interrogation was of 11,078 women in hospitals representing both urban and rural populations. Many of these women were maternity cases and were included as a 'control' group, and the analysis of questionnaires relating to the Royal Commission's questions was confined to the non-maternity group of 3,281 women. The author himself stresses the various sources of bias of the sample, the two main

* Family Limitation and its Influence on Human Fertility during the past Fifty Years. (Papers of the Royal Commission on Population, Volume 1.) Pp. xvi+202. (London: H.M. Stationery Office, 1949.) 4s. net.

ones being the geographical distribution—64 per cent of the histories are from the urbanized areas of London and Glasgow, which contain only 21 per cent of the married women of Great Britain—and the social class distribution—the majority of the respondents were in the less well-to-do classes and unrepresentative of Britain's wives (and their fertility) in several ways. Further difficulties were that many of the women had married young, and many others were mothers of large families.

Several interesting and important facts emerge from this inquiry: the differences in respect of the use of birth control in different generations—only 15 per cent of those married before 1910 had ever practised it, whereas of those married during the years 1935–39 66 per cent had used it—and the increasing numbers who practise it at marriage as well as at subsequent periods; the falling-off in pregnancy-rates as married life progressed, and the lower rates among those who had never used control, an indication of the natural sub-fecundity of the latter; the high pregnancy-rates after control was abandoned, indicating that its use does not reduce the power to reproduce; the proportions using different methods of control, and the steady growth in the use of appliance methods; the considerable differences between the various social classes (three classes were formed according to the occupation of the husband, the first comprising the Registrar-General's classes I and II and the skilled non-manual worker of class III, the second being the skilled manual worker of class III and the third comprising classes IV and V) both in the extent of the use of control and in the methods used; the effectiveness of control, and the pregnancy-rates and fecundity of different groups of women ('fertility' being used in reference to actual births and 'fecundity' in reference to possible births)—it is interesting to note that this report attempts to estimate not only pregnancy-rates according to the statistics collected, but also rates for women using control if they had not used such control, and the 'expected' number of children, as compared with actual numbers; abortion as a method of birth prevention (the report stresses that the figures quoted may be unreliable for a variety of reasons); the extent of involuntary infertility and subfecundity; the proportion of unwanted children, whether first-born or of later order (the use of control did not always guarantee that the family should be of the size planned, but here again the report stresses that this may have been lack of care owing to there being no very strong feelings in the matter of family size); the reasons for the use of control; and other relevant factors such as education and religion.

All these facts are highly important and worthy of further study and investigation. That the fertility-rates arrived at are too high seems indicated not only by reason of the various forms of bias referred to, but also by a comparison of these with rates derived from another of the Royal Commission's investigations, namely, the Family Census, and this report gives comparisons of rates derived from the two inquiries. Many questions are only touched upon in this inquiry, not the least of which is abortion as a method of birth prevention. Many other questions have not been asked at all, since they were not considered relevant to the Commission's inquiry. But such questions as the source of education on the subject of birth control, and the source of education (particularly of women) on the subject of marital relations and conception would seem to be questions the answers to which might indicate the paths along which future policies for population increase might develop. The need for the raising of the reproduction-rate in Great Britain brings forth many such questions, on the answers to which policy might depend. This inquiry has undoubtedly helped to give the answers to many questions of past and present practice, and in so doing has, by bringing forward factual information on a subject which until now has been a matter of hearsay and speculation, created a landmark for the future.

FURTHER VIEWS ON PLANT EVOLUTION

The Birth and Spread of Plants

By Dr. J. C. Willis. (Reprinted from *Boissiera*, Vol. 8.) Pp. xi+561. (Geneva: Conservatoire et Jardin botaniques de la Ville, 1949.) n.p.

THIS book completes the trilogy which was begun with "Age and Area" in 1922 and continued with "The Course of Evolution" in 1940, and Dr. Willis is to be congratulated on thus rounding off a life-time's work on the evolution and distribution of plants.

"The Birth and Spread of Plants" is a much larger book than either of its predecessors. This is partly, it must be said, because it reproduces much of their subject-matter, and partly because there is some other repetition too; but even allowing for this it forms a considerable addition to the literature of plant evolution. In it, with great wealth of detail and an obviously deep sense of conviction, its author expresses his mature conclusions about this most fundamental of botanical subjects.

As Dr. Willis has himself explained, he was at the outset of his professional career an orthodox and warm supporter of the theory of natural selection; but later, and with increasing experience of tropical plant life, he became more and more conscious of the inadequacy of this as a general explanation of evolution, and began to search for something more satisfying and more in accordance with the facts as they appeared to him. In this search two important influences played a part—his association with the late H. B. Guppy and his realization of the principle of 'age and area'. Like Guppy, he found in differentiation the more acceptable evolutionary theory that he sought, while in 'age and area' and its corollaries he saw what he regarded as strong evidence supporting this view against that of natural selection.

The explanation of this appears to be as follows. The conception of differentiation (which is not in itself a new theory) adopted by Guppy and Willis is that, in evolution, the major groups, such as families, are first formed by mutations of relatively considerable magnitude, and for a time consist only of one monotypic genus each. Afterwards these families differentiate by repeated, but on the whole smaller, mutations, into larger numbers of more closely

similar smaller categories, such as become recognized as genera and species. Hence differentiation is evolution by sudden change, as opposed to evolution by natural selection, in which divergence is gradually brought about by the accumulation of successive small variations. Since evolution by differentiation will not necessarily involve that destruction of parental forms which Willis accepts as an essential part of the conception of natural selection, the course of speciation on the former plan should conform more or less closely to a 1,2,4,8, . . . geometrical progression, or compound interest. The 'hollow curves' to which Dr. Willis was the first to direct serious attention seem to him clearly to indicate such a progression, and he therefore regards them, and with them the principles of 'age and area', 'size and space' and 'age and size', as evidences of a differentiation process in evolution. The nature of this process he depicts in some detail, and to it he gives the name of the 'law of dichotomous divergent mutation'.

"The Birth and Spread of Plants" is thus primarily an attempt to establish this law and, as the author expresses it, to show that evolution "works *downwards* from larger divergences to smaller, and not, as hitherto supposed, in the upward direction" (p. 3). This being so, it must be the reviewer's task to give an opinion as to how far this object has been attained.

With Willis's basic contention, that natural selection is not a satisfactory general explanation of evolution, many people, and especially those whose experience has been with plants, in which the putative operation of natural selection is much less simple than it is in animals, will doubtless agree, if for no other reason than that natural selection only comes into operation after new forms have been produced and therefore cannot determine speciation. But Willis goes further than this merely negative conclusion and maintains with fervour a different theory, and it is in following him here that some difficulty may be encountered.

It seems unlikely that we shall ever catch Nature red-handed in the act of evolution (except perhaps by chance), and the evidence for the process must therefore be circumstantial evidence, that is to say, an accumulation of probability derived from the widest possible consideration of biological facts. Only a survey of these facts can help us, and each person must value them according to his own lights and draw his own conclusions from them. Whether any particular point of view regarding evolution is capable of actual proof may be doubted, and, had Dr. Willis allowed the striking array of facts which he has marshalled in his book to speak rather more for themselves and rather less for his particular theories, his results would have been the more convincing and the task of a reviewer easier. As it is, the main issue, which ought to have been kept crystal clear, tends to be clouded by the intrusion of subsidiary, and not always strictly relevant, considerations. In short, Dr. Willis claims a degree of conclusiveness in his arguments which is more than can reasonably be expected, with the result that the would-be supporter of his theories is likely sooner or later to find something which he cannot quite digest, and which may make him unduly antipathetic to the rest.

This is really the crux of the matter. In his enthusiasm for the theories he puts forward, and with which, in their simpler form, few will quarrel, the author too often finds the objective argument insufficient and invokes the more subjective in a way which tends to strain the reader's sympathy. Such, for example, are his frequent use of arithmetical values resulting from man-made classification, like the numbers of various genera and species and the 'hollow curves'; and his use of terms which suggest implications which it would be difficult to substantiate, like his reference to the largest genera of certain groups as "leaders" of those groups. That they are the largest is an objective fact: to say that they are leaders implies other and more disputable values.

It may be thought that criticism of this kind, about a book of such wide scope, is trivial; but this is not so, because it is just this lack of a sustained austere standard which is the chief defect of a book, which, despite it, is a very remarkable one. It is also almost certainly the reason why some of the author's work, and more especially his two preceding books, have not always received the attention they deserve or carried conviction in the way which their writer makes clear he hoped for. Because of it his critics have too often had at hand a weapon which they were not slow to use, and it has allowed the attention which should have been concentrated on the essentials of Dr. Willis's argument to be dissipated in controversies which, although in one sense important enough, are in the final resort no more than side-issues. It is very important that this should be stressed, because it would be unfortunate indeed if this were allowed to obscure the value of this latest and most comprehensive of the author's books, for to the more persevering reader it is both suggestive and stimulating.

It must not be forgotten that evolutionary theory is itself as much subject to the laws of evolution as anything else, and it is not reasonable to expect that the opinions which held the field last century can equally well satisfy the demands of more modern biology. Revaluation in this field has long been overdue, and towards it the Willis trilogy is a significant contribution deserving very careful consideration.

The book is a reprint from *Boissiera*, which is in turn a supplement of *Candollea*, and is in paper covers. It is well produced in a clear type, and contains fourteen chapters, the last a valuable condensation of the rest. There are also two short appendixes, the second of which is a rather too selective bibliography with comparatively few modern references.

RONALD GOOD

SOME PROBLEMS IN NATURAL PHILOSOPHY

Philosophy of Mathematics and Natural Science
By Hermann Weyl. Revised and augmented English edition based on a translation by Olaf Helmer. Pp. x+311. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1949.) 40*s*. net.

HERMANN WEYL is one of the most learned and versatile of living mathematicians, and the appearance of another book from his pen is an event of major importance. The present volume is not wholly new, for it is a revised and augmented translation of the article "Philosophie der Mathematik und Naturwissenschaft" which was published in Oldenbourg's "Handbuch der Philosophie" in 1927.

At that time, the theories of special and general relativity had reached completion, while the quantum theory, in the form given to it by Planck, Einstein, Bohr and Sommerfeld, was about to be transformed into the modern quantum mechanics. The original work represented with remarkable lucidity the outlook of a contemporary mathematician who was also a profound philosophical thinker; in this present book the former text has been altered in many details, and six new appendixes, amounting to almost a third of the whole, have been added, in order to discuss the many fundamental questions that have arisen from the progress of theoretical physics in the past twenty-three years.

One of the problems Weyl considers is not new, although it long awaited a completely satisfactory solution. It may be stated as follows. In the case of the primary mechanical laws of Nature, the equations of motion are unaltered when we change the sign of the variable which represents the time: so they are not sensible of any distinction between past and future. But the law that 'the total entropy of any closed system can never decrease', which is not a primary law but a law concerning assemblages of vast numbers of molecules, does make such a distinction: the entropy—that is, the loss of organisation—of the assemblage can only increase; it can never diminish. Therefore, if we consider two different states of the assemblage, we can often tell, by calculating the entropy, which of the two states preceded the other in time. The universe is thus a one-way or irreversible system, in which the restoration of a past state of things is impossible. But here comes the difficulty: the law of entropy is based ultimately on the elementary laws of dynamics, such as those relating to impact, which are reversible. How then can irreversibility be deduced from them? As Weyl remarks, a closer examination of the statistical derivation of the entropy law shows that an improbable state (that is, one that is far from thermodynamic equilibrium) will be followed with overwhelming probability after a short time by a state closer to equilibrium; but it also shows that the improbable state will have been *preceded*, a short time earlier, again with overwhelming probability, by a state which (like the subsequent one) is closer to equilibrium. Thus the probability judgments would indicate not only that the earth will be cooler in the future than it is at present, but also that at some time in the past it was likewise cooler than at present. Instead of accepting this latter conclusion, we assume that the true previous state was one *from which* the present state follows with overwhelming probability. This remark provides the key to Weyl's profound and illuminating treatment of the whole question.

After this, he passes to a discussion of determinism and freedom. According to most writers on this subject, during the eighteenth and nineteenth centuries it was believed that the state of a closed system at any instant is determined completely by its state at an earlier instant. However, this belief became untenable after the discovery of quantum-mechanics, so that, in the modern view, there is a definite probability that an atom of radium which is still unexploded at a particular instant will explode during the following year; but this is the only kind of assertion that can be made in advance about the time of occurrence of the phenomenon—there is a true indeterminacy as to the actual moment of disintegration. Weyl does not recognize such a sharp contradiction between the views of the past and the present century; he holds that "the only really consistent form of determinism, which maintains the unconditional necessity of everything that happens, has *never* found a support in physics".

Among the sections of the work that will be read with special interest and appreciation is Appendix A, in which the author expounds the shattering discoveries regarding the foundations of mathematics made by Gödel in 1931. But indeed, the whole book from cover to cover is a marvellous treasury of enlightenment.

EDMUND T. WHITTAKER

A PEDOLOGIST'S PERSPECTIVE

Soils

Their Origin, Constitution and Classification; an Introduction to Pedology. By Prof. Gilbert Wooding Robinson. Third edition, revised and enlarged. Pp. xxi+573. (London: Thomas Murby and Co., 1949.) 32*s*. net.

"IT takes all the running you can do to keep in the same place. If you want to get somewhere else you must run at least twice as fast as that" (Lewis Carroll, "Through the Looking Glass"). The task of writing a text-book to-day is difficult in view of the increase in the speed of advance of the frontier of science. Owing to the lag between writing and publication, fundamentally important ideas are likely to appear in print that may make an author wish he could rewrite many passages even while his labour is in the printer's hands.

Comparison of the latest edition of the late Prof. G. W. Robinson's book with the previous edition shows how fast and how well he could run. The book has been considerably enlarged by the incorporation of new matter, and many passages have been rewritten in the light of recent knowledge. As a text-book it may well be unique in that it gives a personal view of the subject and mainly records those data which tend to support the author's ideas. This is not at all unsatisfactory when the author is broad-minded and widely travelled, for the subject is of world-wide importance and its many aspects and implications can only be grasped by a man of great experience.

The plan and scope are unchanged, and it is gratifying to find the erstwhile chapter on pedogenic processes expanded into two, so that the nebulous boundary between geological and pedological studies is made clearer and the difference emphasized by the much greater attention paid to investigations of the clay-complex—a topic which constitutes the major distinction between the two subjects. The greatest expansion is in the treatment of base-exchange, a property which strongly affects the genesis and utilization of the soils of the world. The physical properties and water-relationships of soils are adequately treated, and the plea for more intensive study along indicated lines can only be endorsed. It is unfortunate that capillary theories of water-movement have become so firmly entrenched, for these ideas pervade both the book and soil science. Little new material has been added to the consideration of podzolic soils. In spite of the amount of work on soil genesis, it is surprising that there are still no generally accepted explanations of the fundamental processes involved in the removal and accumulation of materials in the many different

world-soils; nor is there much new material in the chapter on chernozems, but a much-needed clarification of ideas on hydromorphic soils can be found in the chapter dealing with these soils. Little that is fresh can be said of the saline soils, for the earlier workers seem to have elucidated most of their problems. It must be confessed that the chapter on tropical soils is disappointing; this cannot be attributed entirely to the author, for there are few adequate descriptions and analyses available, nomenclature is not agreed upon and the pedogenic processes involved are not clear.

The classification of soils is an important subject on which there has been much debate, and more can be anticipated, so that the philosophical introduction is both apt and very necessary for many students of soil science, most of whom have a strong practical bias. The feeling arises that Prof. Robinson was unduly modest in the treatment of his own classification, which seems simple to grasp and is adequate for many purposes. It is obvious that recent journeys contributed material to the discussion of the geography of soils. This is a distinct gain, and it is to be lamented that his recent death has prevented his expanding this and the chapters on the soils of the principal world-groups in subsequent editions at the expense of the previous chapters which now contain material of a historical nature—even though the science is but young. One would like to see greater use made of the concepts developed in the earlier chapters to explain the pedogenesis of the soils discussed later. The remaining chapters are germane in so far as they provide the non-technical reader with an insight into both the vast amount of work needed to make a soil map even of small areas, let alone continents, and also of the implications of a subject of importance to the whole human race.

It is easy to find faults and imperfections, for errors have been carried over from the second edition, and there is evidence of poor proof-reading. Such minor points do not greatly detract from what is undoubtedly 'a good thing' and a book that makes the reader think, while opening up many lines of research for the worker who may imagine that the field is unprofitable to plough. D. A. OSMOND

EARTHQUAKE GEOGRAPHY

Seismicity of the Earth and Associated Phenomena
By B. Gutenberg and C. F. Richter. Pp. ix+273. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1949.) 80s. net.

THE geographical distribution of earthquakes and associated phenomena is a very large subject which calls for the exercise of the critical faculty in a marked degree. Since there are about a million earthquakes every year, most of which are recorded at some observatory or other, it becomes necessary for cataloguing purposes to draw the line somewhere between those earthquakes to be included and those to be left out. One criterion would be that the shock should be recorded at more than ten observatories; but, as seismological observatories are not uniformly distributed over the surface of the earth, this method is open to criticism. Drs. B. Gutenberg and C. F. Richter took a big step forward when they defined instrumental earthquake magnitude[1], and the present work is the logical outcome of this definition.

According to these authors, the first effective instrumental record of a distant earthquake was on April 17, 1889. Earthquakes occurring during the years 1904–47 have been classified according to instrumental magnitude: thus class *a* is magnitude $7\frac{3}{4}$–$8\frac{1}{2}$; *b*, 7·0–7·7; *c*, 6·0–6·9; *d*, 5·3–5·9; and *e* less than 5·3. Those of the last class, in general, have been omitted. Earthquakes have been further subdivided according to their depth of focus: shallow, not exceeding 60 km.; intermediate, 70–300 km.; and deep, exceeding 300 km. Even within all the above limits, judgment has had to be used since, for example, most earthquakes in Great Britain are less than magnitude 5·3, and, if all the earthquakes greater than magnitude 6 were included, the Japanese maps would be overcrowded. Seismologists and others interested will thus be indebted to their indefatigable colleagues, Drs. Gutenberg and Richter, for choosing what is significant from a welter of data. The book is in line with the work of the great seismologists of the past, including Montessus de Ballore, Milne and Turner, and brings the work up to date to include the findings of the most recent research.

The present work is intended: (1) to evaluate the present relative seismicity of various parts of the earth, and (2) to discuss very briefly the geography and the geological character of the zones and areas of seismic activity. This includes correlation with alignments of active volcanoes and gravity anomalies, and with oceanic deeps, mountain structures and other topographical features. Mechanism is discussed, particularly with reference to crustal folding and block faulting. Tsunamis are also briefly discussed. The surface of the earth is found to consist of relatively inactive blocks separated by active zones of four groups: (1) circum-Pacific zone, (2) Mediterranean and trans-Asiatic zone, (3) narrow belts of shocks along the principal ridges in the Atlantic, Arctic and Indian Oceans, (4) moderate activity associated with rift structures, such as those of East Africa and the Hawaiian Islands. During the period covered by the book, earthquakes with the greatest magnitudes (near $8\frac{1}{4}$) had shallow foci and occurred on January 31, 1906 (Colombia), August 17, 1906 (Chile), January 3, 1911 (Tien Shan), December 16, 1920 (Kansu), and March 2, 1933 (Japan); there were five intermediate-depth shocks with magnitude near 8, and three deep-focus shocks with magnitudes $7\frac{3}{4}$–8. These few shocks accounted for much of the energy released over the period in question, which was of the order of 10^{27} ergs per year, or roughly 10^9 kilowatts.

As will be realized from the 101 pages (imperial 8vo) of text, which includes short tables, diagrams and numerous maps, the work is not exhaustive, but has been sketched by master hands in bold outline. This is followed by twelve crowded pages of valuable references in 7-point type, and 149 pages of tables. The whole is adequately indexed. In a work of this sort, which will require constant additions and perhaps some revision as more data accumulate and research work is done, it is fortunate that such laboratories as the one at Pasadena exist to carry on the work. This book will be invaluable to students of geophysics, geology, geography, civil engineering and earthquake insurance, and to others interested. As may be expected of a book published by the Princeton University Press, the printing and format are beyond reproach. ERNEST TILLOTSON

[1] Gutenberg, B., and Richter, C. F., "Earthquake Magnitude, Intensity, Energy and Acceleration", *Bull. Seism. Soc. Amer.*, **32**, 163 (1942).

Clinical Electroencephalography

By Dr. Robert Cohn. Pp. vii+639. (New York and London: McGraw-Hill Book Co., Inc., 1949.) 119*s*.

THIS book—which is a compilation of recordings taken by the author over some years—must have a very limited field of interested readers. The first twenty-four pages are devoted to general considerations concerning electro-encephalography: of the remaining six hundred-odd pages, about three hundred are devoted to encephalograms, with twelve tracings per page. Few enthusiasts can be so stalwart as to make their way through these thousands of tracings.

The recordings are arranged in chapters, commencing with those clinical conditions which give the most precisely determined electric correlations, followed by conditions where the tracings are not so clearly delineated. Clinical histories for each set of recordings are given, together with 'impressions' concerning the recordings.

The book is an indication of the mass of material which the author has studied. A list of books and articles which the author recommends for reference reading is given at the end of the book.

The Chemistry and Technology of Enzymes

By Dr. Henry Tauber. Pp. viii+550. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1949.) 45*s*. net.

IN this book, the author has put together in a revised form his two previously published works on "Enzyme Chemistry" (which appeared as a mimeographed monograph) and on "Enzyme Technology". Users of the former will be glad to see it in a more permanent and readable form. As the first part of this volume, it now offers in some 260 pages an excellent and up-to-date brief review of enzyme chemistry, which gives clear instructions for the preparation of many pure enzymes and for their estimation.

The second part of the book, on "Enzyme Technology", follows the same lines as its predecessor; but it has been brought up to date and will be very useful to all who are concerned with the industrial use of enzymes. The author interprets enzymology very widely—for example, his chapter on the production of antibiotics such as penicillin and streptomycin. The magnitude of these new industries is indicated by the statement that the production of penicillin in the United States in 1947 was twenty tons, and no doubt is by now much greater. Other interesting chapters deal with yeast, mould and bacterial fermentations, and recent developments in their industrial exploitation. J. A. V. BUTLER

Biology and Man

By Dr. Francis G. W. Knowles. (Harrap's Torch Books.) Pp. 304. (London: George G. Harrap and Co., Ltd., 1950.) 10*s*. 6*d*. net.

THE senior biology master at Winchester College has already built up a sound reputation as the author of several successful biology text-books for schools. His latest work is aimed at the general reader, and in it he seeks to interpret the relationships between various forms of life. For this purpose the book is divided into two parts, the first dealing with some of those animals and plants which directly affect man, and the second with the study of the anatomy, functions and evolution of man's body.

The arrangement of the text is along traditional lines, except that two separate chapters are devoted to the biology of the potato and wheat; the author might have come nearer to his general purpose if these chapters had been devoted to the biology of the breakfast or lunch table. In his epilogue, too, which describes the economic and medical value of biology to man, the author might have interested a larger audience if he had devoted more attention to the sociological implications of biology. The book is admirably illustrated with line-drawings and diagrams. T. H. H.

How Your Body Works

By Dr. Geoffrey H. Bourne. Pp. xvi+228+16 plates. (London: Sigma Books, Ltd., 1949.) 12*s*. 6*d*. net.

THE increasing number of books on elementary physiology now appearing may be regarded as an encouraging sign that this subject is being more widely taught in schools. The author of the present volume, who rightly deplores the little provision hitherto made, can feel that he has made a useful contribution for teaching a subject which he describes as one of absorbing interest and one in which lack of knowledge can lead to distorted views.

Dr. G. H. Bourne departs somewhat from the normal text-book pattern in approaching his subject from the historical angle. This approach is extremely well used in the chapters on blood, circulation and respiration; but in those on food, digestion and metabolism it gives a somewhat disjointed effect. The slighter treatment of other systems of the body is the penalty paid for using this unusual approach in a book of limited size. But it should be pointed out that, apart from the interest of the early history, this approach gives an opportunity of showing the spectacular results that have accrued from uniting the modern method of experiment with that of observation and speculation used by workers in this field in the early days. W. C. C.

Snow White

The Story of a Polar Bear Cub. By Jan Vlasák and Josef Seget. Edited by Dr. Maurice Burton. Pp. viii+88. (London, Edinburgh and Glasgow: William Hodge and Co., Ltd., 1949.) 12*s*. 6*d*. net.

THIS is a charming book which will appeal to children of all ages and even to those of us who are old in years but have remained children at heart. The story of the upbringing of the wee bear, a story which is illustrated by a series of delightful photographs, makes us admire the devotion of the human nurse, who had to be awake, to feed the cub from the bottle, at short intervals throughout the twenty-four hours. At her earliest stages the little bear resembles, in the photographs, a children's toy, yet there is great intelligence in her eyes even from the first.

The rearing of the little bear took place in an occupied country during the war years and was thus the more noteworthy. Hand-rearing was a last hope, for the mother had shown that she was unable to rear her cubs; yet it was difficult to take 'Snow White' from her. Her feeding had to be severely rationed, and on the rare occasion when the ration was exceeded (owing to 'Snow White's' pleading) the cub became ill—indeed, on one occasion her life was for a time despaired of. The book is well produced, and I can imagine no more acceptable present to give a child. SETON GORDON

THE NATIONAL INSTITUTE FOR RESEARCH IN DAIRYING*

By Prof. H. D. KAY, C.B.E., F.R.S.

THE dairy industry in the United Kingdom to-day is of a size which few, even those working in the industry, fully realize. Including the dependants of those actually engaged in milk production or utilization, approximately five per cent of the total population of Great Britain is supported by it. In liquid milk alone, the value of the present annual turnover exceeds £200 million.

Despite the steadily growing consumption of liquid milk and the increasing manufacture of cheese and butter in the United Kingdom during the nineteenth century, surprisingly little planned experiment in relation to milk production or manufacture was carried out. In the twenty years before the establishment of the National Institute for Research in Dairying, F. J. Lloyd, Charles Crowther, Droop Richmond and Thomas Orr were among the few who concerned themselves with the scientific problems of the industry. Apart from this work, advances in dairying in Britain were almost abjectly dependent on findings made in countries abroad, and many of them were inapplicable to conditions in Great Britain.

The National Institute for Research in Dairying was one of the centres set up by the Development Commissioners under the Development and Road Improvement Funds Act of 1909 for "promoting scientific research into the problems of the agricultural industry". It was established in 1912 at University College, Reading, with a staff of, literally, two men and a boy—Stenhouse Williams, a bacteriologist, John Golding, a chemist, and W. A. Hoy. Its accommodation was a cellar and an attic in an old Victorian house, and its income for the first year was £1,600. The drive and determination of Stenhouse Williams saved the Institute from foundering during the First World War; but it was not until 1920 that sufficient funds were raised to enable the Institute to obtain more suitable quarters at Shinfield, three miles south of Reading, where the Manor estate of some 350 acres was purchased. Part of the Manor House was converted into laboratories, and a herd of dairy cows was built up. From 1924, there was an increasing flow of research findings from each of the three Departments—Bacteriology, Chemistry and Dairy Husbandry—of the Institute. The problems of improving the methods of production and handling of milk, to avoid the hitherto extensive losses of milk as a result of the souring which then took place whenever the atmospheric temperature rose a little, were among those tackled at this period. Better methods of chemical analysis of milk, the scientific control of cheese-making and the prevention of undue wastage of dairy cows from commercial herds also received close investigation. The value of steam on the farm and in the distributing plant for sterilizing all milk equipment at regular and frequent intervals was clearly demonstrated, and this idea, rather revolutionary at first, has now almost completely permeated the industry. Milk fever in newly calved cows was shown to be a metabolic disorder associated with hypocalcæmia. Methods of economical calf-rearing were worked out, the relative effects of good and poor nutrition of dairy heifers on their subsequent milk production were studied, and the ability of dairy bulls to convey milking qualities to their progeny was examined.

While these and various other researches were in progress, Williams continued his efforts to raise further funds for the Institute's development. Unfortunately, his health began to break down and he died rather suddenly early in 1932 when returning from a public engagement in Ireland.

At this stage the organisation of the Institute was as follows: its governing board, though connected with the University of Reading, was, in fact, an autonomous body, functioning under the terms of a trust deed. On the board was represented the University of Reading, the Ministries of Health and Agriculture, the Royal Agricultural Society and other agricultural and dairy farming organisations, the dairy processing and manufacturing industry, the subscribers to the trust funds and certain other persons. The same organisation exists to-day. The connexion with the University of Reading is very close; postgraduate students of the University work at the Institute for higher degrees, and a small amount of undergraduate teaching may also be undertaken. The director is a research professor of the University, and the permanent members of the Institute staff are given university privileges.

At the present time (April 1950) the work of the Institute is organised in seven main departments: dairy husbandry in charge of A. S. Foot, feeding and metabolism in charge of Stephen Bartlett, physiology in charge of S. J. Folley, bacteriology in charge of A. T. R. Mattick (who is also deputy director), chemistry and physics in charge of G. W. Scott Blair, dairy engineering in charge of H. S. Hall, nutrition in charge of S. K. Kon. There are three smaller sections: statistics in charge of C. P. Cox, the experimental dairy in charge of D. V. Dearden, and the library in charge of Doris Knight. Some seventy graduates are now working at the Institute; fifty-one of them are in one or other of the scientific or experimental officer grades. Including farm workers and skilled tradesmen, the total staff numbers 220, and the yearly income is now approximately £100,000.

It had been recognized, for a year or two before Williams's death, that the first stage in the development of the Institute, during which mainly *ad hoc* problems had been tackled, was coming to an end and that a different and more fundamental approach to a number of the problems of the industry, together with new techniques, would be required. Physiological, biochemical, nutritional and physical methods of attack were likely to be needed, and questions of machinery were also becoming more insistent. More facilities on the farm, more cows for experiment, better equipped laboratories and a strengthened staff were needed urgently. With the aid of private subscriptions and small grants from public funds, a new library, some new farm buildings, a small machinery-testing shop and later a small laboratory block were built between 1934 and 1938. The Commonwealth Bureau of Dairy Science was established in 1938 and provided with accommodation in the library of the Institute.

During the period 1933–39, a number of important investigations were carried out, among which a few only can be cited. In dairy husbandry, it was shown that the protein requirements of dairy cows for milk production were 20 per cent lower than the previously accepted figure. It was clearly demonstrated that

* Summary of a lecture given to the Royal Society on April 27.

ordinary bulked commercial raw milk and the same milk pasteurized gave no detectable difference in growth-rate when fed to calves, rats or children. The effects not only of pasteurization but also of sterilization, condensing and drying, on the nutritive value of milk were studied, and those of pasteurization were shown to be negligible. It was found, however, that ordinary daylight destroyed vitamin C in milk fairly rapidly. The new method of high-temperature, short-time pasteurization was thoroughly investigated and shown to be effective if carried out at 161° F. for 15 sec. 'holding'. The phosphatase test for efficiency of pasteurization was devised. The length of time of survival of tubercle organisms in infected pastures and in dairy products made from infected milk was determined. The precursors, in the blood of the cow, of the milk constituents were studied and the effect of feeding thyroid gland or administering pure thyroxine to lactating cows was shown to be a rise both in milk yield and butterfat percentage. Taints in milk were examined for cause, and methods of prevention worked out. Some preliminary work was done on the problem of defective compositional quality in milk. Many other problems, ranging from the very practical question of the efficiency of bottle-washing machines to an academic inquiry (with potentially important industrial bearings) on the site in the animal body of the conversion of the plant pigment carotene to vitamin A, were investigated.

The outbreak of war in 1939 led to a diversion of effort to urgent problems of possible war-time significance. The better use in dairying of home-produced feeding stuffs, the organisation of a national scheme for maintaining, and if possible improving, the keeping quality of milk to prevent any souring losses, emergency methods of cleansing dairy apparatus, the prevention of the serious effect in the cheesemaking industry of 'slow' starters, rheological methods for the assessment of cheese quality, the purification and crystallization of the enzyme, rennin, the use of iodinated proteins for increasing milk yields, the induction of an artificial lactation in a sterile or virgin heifer or in a barren cow by treatment of the animal with synthetic œstrogens—all these indicate a few only of the activities of the Institute staff during the War. Further, the serious fall in the compositional quality of milk which took place during the late winter months of the war years —and which is still with us—was carefully investigated. Arising out of this work is the more recent (1948) finding that certain British species of grass and of clover contain an active œstrogen, the identity of which is now being sought. A simple apparatus for determining whether or not a cow is 'on heat' was devised.

At the request of the Ministry of Agriculture, an experimental artificial insemination centre was established at the Institute in 1942. The lessons gained were of value when a nation-wide scheme for artificial insemination was launched in 1944. In 1949, 21,000 cows were inseminated artificially from Shinfield, while the total number for England and Wales was nearly 500,000, about one seventh of the total dairy cow population.

The phenomenon of 'let-down' of milk in the cow, both in its physiological relationships and in its more practical bearings on milking technique and the design of milking machines, has been and is still being studied. The 'let-down' appears to result from the contraction of the myo-epithelial network surrounding the secreting alveolus, under the action of a hormone of the posterior pituitary gland. The hormone is liberated following either tactile stimulus of the teat or by some other sensory stimulus associated by the cow with milking. Further work on the biochemistry of milk formation, using the Warburg technique with gland slices and also radio-tracers, has shown that one of the principal sources of milk fat is the circulating acetate in the blood of the ruminant. Bacteriophage has been shown to be responsible in several cheese-making factories for 'slow starter' difficulties, and successful methods for overcoming this trouble have been demonstrated to the staffs of these factories. The keeping quality of spray-dried milk has been markedly improved by a method devised during the War. Shortly after the War, a new antibiotic, nisin, was isolated from a culture of a lactic acid streptococcus. Nisin has since been demonstrated to have very promising *in vivo* potentialities against a number of diseases. It has been crystallized and its composition is being examined.

PRODUCTION AND APPLICATION OF HIGH-INTENSITY X-RAY BEAMS

A CONFERENCE organised by the X-ray Analysis Group of the Institute of Physics on "The Production and Application of High-Intensity X-ray Beams" was held in the Royal Institution during April 13–14.

Two quite distinct methods of approach to the problem of obtaining X-ray beams of high intensity were described at the conference. On one hand, there is the method worked out from 1927 onwards by the late Dr. A. Müller and developed practically in collaboration with Mr. R. E. Clay. They used a comparatively large rectangular focus in conjunction with a rapidly rotating anode and, in this way, were able to achieve high power-loadings without damage to the target. The other method is to concentrate the electron beam into an exceedingly small region of the anode. In this way, high specific loading can be achieved with a small power input, and the brilliance of the point focus is considerable. As the heat flow from a point occurs in all directions (radially into the target volume), the dissipation of heat is much more rapid than in the case of the large focus treated by Müller (and, later, by Oosterkamp), where the heat flow is effectively linear (normal to the surface of the target only).

So marked is this effect that, as was stated by Dr. W. Ehrenberg and Mr. W. E. Spear at the conference, there is now little advantage to be gained in rotating the target. These workers gave a most elegant solution of the problem in electron optics of achieving a point focus. The essential feature of their generator is the fact that filament, grid (or focusing shield) and the outer tube are all at the same potential. In the conventional X-ray tube, the outer casing is earthed, and is at the same potential as the earthed anode. In Ehrenberg and Spear's design, the filament, grid and outer casing are all earthed, and the insulated anode is maintained at high potential. With this very simple arrangement, they obtain a focus the diameter of which is of the order of 0·04 mm., and are able to use a specific loading of 12 kW./mm.^{2} for long periods without injuring the target.

A more elaborate micro-focus X-ray tube was described and demonstrated by Mr. R. Witty and Mr. P. Wood. A biased electron gun forms a first image of dimensions 1 mm. × 0·1 mm., and an electromagnetic lens is used to reduce this to 0·1 mm. × 0·01 mm. A specific loading of 50 kW./mm.^{2} has been achieved on a focus of size 0·05 mm. × 0·01 mm., but the target was damaged after an hour of working by this method.

The moving-anode type of tube has been brought to a high level of convenience by Dr. A. Taylor. He described two different designs for a 5-kW. generator, one of which employs only static vacuum seals. The other assembly is very easily dismantled and allows the anode to be changed in less than two minutes. Dr. J. S. Woldringh gave particulars of the five rotating-target tubes which exist in Holland and which follow British practice closely.

The usual practice with rotating-anode tubes is to use a line focus and to take off the radiation at a small angle in order to foreshorten the line into a rough square. Dr. D. P. Riley argued that there are limits to this method of obtaining a fine X-ray source. From Müller's expression for a true focus of large dimensions, it follows that for a given generator working under given optimum and safe conditions, there is a fixed relation between the length and width of the focus. Once the width is defined by the degree of focusing used, the 'safe' length can be derived and this length varies directly with the power input. Thus, a combination of fine focusing and high power necessitates a very long focus which would be difficult to foreshorten sufficiently. The situation, however, would be expected to be qualitatively different once a sufficiently fine line focus were obtained, as, in this case, the heat flow would be approximately cylindrical instead of linear, and higher loadings than those permitted by the Müller formula could be used. These conditions have probably now been reached in the modified 50-kW. generator. An even line focus of width 0·1 mm. has been obtained without the necessity of biasing by using a tungsten strip filament.

Mr. J. S. Thorp has derived fine line foci by using bias but complained of a marked banded structure in the equipotential case. He uses a tungsten wire filament of diameter comparable to the size of his cathode tip, which is much smaller than that employed in the above case, which may explain the difference between his and Dr. Riley's results.

While agreeing that a numerical comparison of the relative performance of different tubes is needed, the conference failed to produce a definition of a 'factor of excellence' of an X-ray generator.

The question of collimation and the production of monochromatic beams was next considered. Dr. I. MacArthur described the preparation of stop slits from a lithium–bismuth alloy by pressing it around ¼-mm. diameter steel pins. He also discussed the limitations of very fine capillary slits made from lead glass and showed that secondary diffraction effects make them unsuitable for use at very low angles of diffraction. The principle of the total reflexion of X-rays from a smooth surface has been employed by Dr. Ehrenberg to make a focusing mirror of high resolution and great concentrating power. The great theoretical advantage of the method is, however, diminished by virtue of the roughness to X-rays of even the best optical flat. Dr. P. M. de Wolff gave an account of Tiedema's method of obtaining large aluminium crystals in the form of lamellæ with any desired orientation. Johannsen-type monochromator crystals can be obtained in this way without the necessity of grinding. Dr. de Wolff himself employs quartz as his monochromator crystal and showed that a strip of it can be bent into a great variety of curves by using four loads. Such monochromators have been used with multiple focusing cameras for some time in Delft and give very high resolving power and gain of intensity. Mr. P. Gay has extended the work of Hirsch and Kellar on asymmetric Bragg reflexion from obliquely ground crystals and advised the use of lithium fluoride where maximum intensity is sought and of calcite if maximum resolution is the aim. Lithium fluoride has also been used, as Dr. W. H. Taylor reported, by Dr. H. E. Hargreaves in a 30-mm. focusing monochromator to separate the $K\alpha_1$ component of iron radiation. This technique, also used in France, has allowed him to obtain very sharp and clear powder photographs of copper–iron–nickel alloys.

The conference then heard a number of very short communications on different techniques useful in connexion with X-ray analysis. M. G. Fournet described the use of two bent-crystal monochromators in series to suppress parasitic scattering due to crystal imperfections, and Compton and thermal scattering. He has recorded a diffraction band at 240 A. from egg-yolk with this apparatus. Mr. H. Smith gave details of his method of producing thin sheets of beryllium by bombarding the metal with electrons under high vacuum. Foil only 0·1 mm. thick has been produced and used for X-ray tube windows. Mr. E. G. Steward showed how simple devices could be attached to standard cameras to allow work at moderately high or low temperatures. Dr. W. J. Oosterkamp gave a stimulating analysis of the possibility of using radioactive isotopes as a source of monochromatic K-radiation. He concluded that an isotope with a half-life of one day would, in this respect, be roughly equivalent to a stationary target tube. This short half-life made it an uncompetitive method. Dr. O. Lloyd Richards demonstrated how sprung models of close-packed structures can clearly illustrate the slight atomic rearrangements which take place in a metal under tension or on rolling.

The third session of the conference dealt with the application of high-intensity X-ray beams to research problems and ranged over a great variety of topics. In many studies, high intensity may be a great convenience but is not essential. It becomes essential when, for example, time-dependent processes of short duration are to be investigated or when the specimen is unstable or deteriorates with time. Few examples of the second class of problem were given at the conference, and it appears that, as yet, powerful tubes are being used mainly to save time in long exposures. This, in itself, if the gain is sufficient, makes it an economic matter to study systems which diffract X-rays only exceedingly weakly.

In the field of biological and colloid chemistry, there are many applications of this type, some of which were reported by Dr. D. P. Riley. The structure of oil–water–soap emulsions has been investigated with Dr. J. H. Schulman and Dr. T. S. MacRoberts. Droplet diameters up to 700 A. have been measured and are in good agreement with values found by the light-scattering method and predicted on chemical grounds. With Dr. D. Herbert, preliminary figures for the dimensions of protein molecules (human hæmoglobin, egg albumin) have been derived from the diffraction patterns given by concentrated solutions. In the case of egg albumin, there is evidence

of molecular association even in quite dilute solutions. In collaboration with Dr. G. Oster, it has been shown that gels and solutions of deoxyribonucleic acid (sodium salt) from thymus possess a pronounced micellar structure of a lattice type, which swells on dilution. In addition, there is evidence that the molecule itself can swell. The parent nucleoprotein also gives definite low- and medium-angle diffraction bands. Both substances are being further investigated because of their importance as constituents of living cells.

Another important field in which the use of high-intensity sources is almost obligatory is that of the diffuse scattering of X-rays by single crystals. Dr. P. G. Owston showed examples where, without monochromatic radiation, much fine detail was lost. The use of monochromators with a standard tube involves exposure times of several days, and each crystal has to be photographed in many different orientations. High-power tubes drastically reduce the time taken by such a survey. Further, when Geiger-Müller counters are used, the 'background' counts set a lower limit to the detectable intensity and to the accuracy with which weak scattering can be measured. A high-intensity X-ray source is indispensable if this obstacle is to be surmounted. Dr. Owston also described researches involving the recording of very weak Bragg reflexions arising from the lack of spherical symmetry of electron clouds around atoms. Information on the position and state of bonding of hydrogen atoms might be obtainable in this way.

Mr. P. B. Hirsch contributed an account of a micro-beam technique applied to the study of cold-worked metals. Back-reflexion photographs were taken of cold-rolled aluminium with a beam of diameter about 35 microns and different divergences. The diffraction patterns consist of 'spotty' rings, and from the number of spots the mean grain-size of particles within the metal can be determined. For heavily cold-worked aluminium, examined a year after rolling, this mean size is about 2 microns. As the spots on the diffraction rings are themselves broadened, it is concluded that the breadths of the diffraction lines obtained by the usual methods are partly due to the breadth of the small spots of which they are constituted. The breadths of the spots are explained in terms of distortion and shape of the particles. It was found that this broadening decreases with time after rolling, as does the particle size.

Dr. I. MacArthur presented a great number of comparative data on homologous series of long-chain compounds under varying conditions. Discontinuous and continuous transitions were both observed as one varied the chain-length, nature and position of the polar group and temperature. For a full interpretation of the many effects, account must be taken of other physical chemical data. The X-ray method, used in isolation, loses much of its power in such cases.

It was found during the investigation of the properties of the parallel-beam concentration monochromator that a surface layer of disordered material is formed when the crystal is ground. Mr. P. Gay has studied the surfaces of abraded crystals with the X-ray and electron diffraction techniques and correlated the results with the intensity of reflexion from the same crystals.

The conference served a useful purpose in bringing together people who had obviously been working along similar lines, but in isolation, and showed others that very powerful techniques are now available for their particular X-ray diffraction problems. Little experience has yet been had with the high-intensity beams; but, in conjunction with sensitive detectors, such as Geiger–Müller counters, they cannot fail to open up new avenues of structural exploration of ordered matter. As Prof. J. D. Bernal said, thought now needs to be given to new types of camera for use with the new tubes in order that they be used most effectively.

On this occasion, an agreeable and stimulating evening lecture was given by Prof. A. Guinier, of Paris, who took as his subject "The Role of High-Intensity Beams in the Progress of X-ray Analysis".

D. P. Riley

CORRELATION OF ELECTROPHORETIC STUDIES AND OTHER FACTORS IN THE SYNDROME OF SECONDARY SHOCK

By Prof. DAN H. MOORE
AND
Dr. C. L. FOX
College of Physicians and Surgeons, Columbia University, and the U.S. Office of Naval Research, London

Numerous factors are involved in the complicated syndrome of shock. Blalock[1], Nickerson[2], Ashworth, Jester and Lloyd[3] and others[4] have shown that the loss in circulating blood volume could be accounted for by the gain in weight by traumatized area. From these observations many investigators have concluded that the symptoms observed in shock result from this loss of blood.

On the other hand, in experiments dealing with tourniquet shock in dogs, Scott[5] has shown that there is no difference in the quantity of fluid lost into the site of injury of dogs which die and of those which spontaneously recover. Moreover, Wang *et al.*[6] have produced quantitative data which show that in hæmorrhage the residual blood volume at 50 per cent mortality in dogs is 59 c.c. per kgm. of body-weight, whereas in trauma 50 per cent mortality occurs when the residual blood is 73 c.c. per kgm. of body-weight. The shift of potassium from the traumatized area into the blood and the loss of sodium from the blood as well as shifts in other ions have also been demonstrated to be of importance[7–10].

Other substances from the traumatized area, such as tissue factors[11] and enzymes, have also been postulated. In the studies reported here quantitative and qualitative analyses have been made of the shift of proteins and other substances from the circulatory bed into the traumatized areas, and from the traumatized areas into the blood.

Tissues of Swiss albino mice were traumatized by the method of Rosenthal[12], which here consisted of a tight tourniquet on one of the hind-legs for two hours, followed by release. The degree of shock which followed was found to be dependent upon the environmental temperature and humidity. When the experiments were carried out in summer, the degree of shock and the fatalities were decidedly greater than in winter. At a temperature of 20° C. and humidity of 50 per cent, or at a temperature of 32°–35° C. and a humidity of 5 per cent, none of the animals died within six hours. At a temperature of 32°–35° C. and a humidity of 75 per cent or more the mortality was

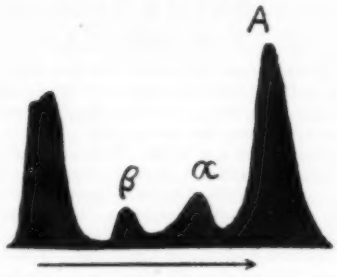


Fig. 1. Electrophoretic pattern of serum from mice 1 hr. after release of 2-hr. tourniquets

high, large numbers dying within the first hour after release from the tourniquets. Electrophoretic studies made in a buffer 0·02 *M* with respect to sodium phosphate and 0·15 *M* with respect to sodium chloride, *p*H 7·4, revealed that a large quantity of protein having a mobility similar to γ-globulin (see Fig. 1) existed in the serum one hour after the release of the tourniquets. The same changes in the serum pattern (see Fig. 2) occurred during shock produced by burns inflicted by the method of Rosenthal[13]. The quantity of this new protein was found to be proportional to the severity of shock symptoms, which were dependent on the environmental conditions, as described above. In 5–6 hours this new component disappeared in the animals that recovered. At low temperature and humidity, however, the serum pattern changed little from normal. Concomitant with the appearance of this new protein in the serum, there was a decrease in the amount of blood obtainable from the animals as well as a decrease in the serum protein concentration. Mice in profound shock would yield only a drop or two of blood, whereas normals or those injured but not in shock would yield more. More than 1 c.c. could be obtained from normals. The amino-nitrogen of both the serum and urine obtained from the animals in shock was increased. Moreover, the blood obtained from animals in shock was always strongly hæmolized. This is a common observation in secondary shock produced by other methods in other species (refs. 14, 15 and others).

In order to determine whether the injured leg had gained or lost protein, a critical analysis was made by amputating both hind-legs one hour after the release of the tourniquet which had been applied to one of them. Comparative data obtained on the injured and uninjured legs is recorded in the accompanying table. Wet weights were obtained immediately after amputation. Dry weights were obtained after the legs had been desiccated at 110° for one week. The legs were then digested, and the quantity of nitrogen (Kjeldahl) in each multiplied by the factor 6·25 (to convert approximately to protein) is recorded in the fourth column. It is evident from these results that, although the legs had gained considerable water, the dry weight and the total protein had not changed appreciably.

Protein Content of Injured and Contralateral Uninjured Legs of Mice (Injured Leg Values Appear Above Opposite Uninjured Leg)

Animal	Wet weight (gm.)	Dry weight (gm.)	Protein content (gm.)
1	1·148	0·270	0·160
	0·852	0·273	0·162
	+0·296		−0·002
2	1·038	0·266	0·166
	0·780	0·271	0·172
	+0·258		−0·006
3	1·880	0·454	0·336
	1·270	0·432	0·323
	+0·610		+0·013
4	2·012	0·463	0·298
	1·385	0·473	0·302
	+0·627		−0·004
5	2·074	0·536	0·291
	1·491	0·522	0·360
	+0·583		−0·069
6	1·959	0·395	0·251
	1·132	0·370	0·232
	+0·827		+0·019
7	2·002	0·408	0·261
	1·343	0·432	0·275
	+0·659		−0·014

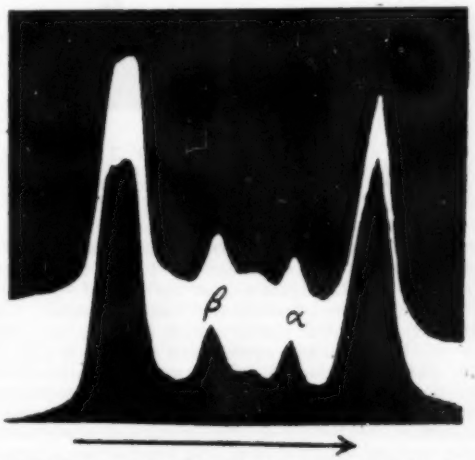


Fig. 2. Electrophoretic pattern of mouse serum taken 1 hr. after burns produced by immersing their posterior limbs into water at 70° C. for 5 sec.

In order to study the proteins in the injured and uninjured tissues in more detail they were extracted in the following way. The legs, usually four, were placed in a 50-ml. thick-walled centrifuge tube containing 25 ml. of the above-described phosphate–saline buffer and mashed vigorously with a flattened glass rod. During this procedure the tubes were chilled in an ice-bath. After centrifuging in the cold the supernatant was decanted and filtered through a coarse Seitz pad. An electrophoretic pattern of the extract obtained from normal and injured legs is shown in Figs. 3*A* and *B* respectively. Component No. 1 has the mobility of serum albumin. After injury, the amount of this component is greatly increased, indicating that there is a loss of serum albumin into the traumatized area. A component having the mobility of α-globulin, however, does not appear in the material obtained from the injured leg. Although the proteins extracted from uninjured tissue did not contain hæmoglobin, it was shown that a considerable proportion of the slow-moving component in the material extracted from the injured leg was hæmoglobin. The pattern of Fig. 3*C* was

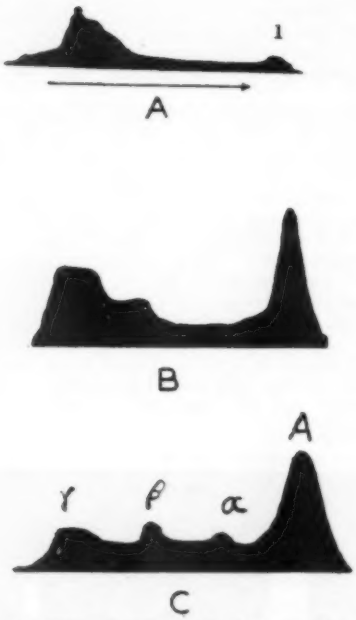


Fig. 3. Electrophoretic patterns of: (*A*) normal mouse leg extract; (*B*) extract from legs 1 hr. after release of 2-hr. tourniquets; (*C*) mixture of normal tissue extract (5 parts) and normal serum (1 part)

obtained by combining normal tissue extract with normal serum. The dissimilarity of Figs. 3*B* and 3*C* indicates that the extract from the injured leg is not a simple mixture of serum and tissue proteins. The data of the table indicate that there is as much protein lost from the injured area as there is gained. The patterns obtained on the serum of animals in shock also indicate a large gain of proteins having low mobility. By means of photometric and ultracentrifugal analysis, it was found that the new proteins in the serum consisted of tissue proteins, hæmoglobin, and products of digestion. It was further shown that hæmolysis occurs when fresh tissue is mixed with whole blood or separated erythrocytes. If the tissue is not fresh or has been heated, hæmolysis does not occur. Logaras[16] has shown that urea inhibits the severity of shock following the release of tourniquets in rats. We have shown that 0·04 *M* urea in 0·11 *M* sodium chloride inhibits the lysis of erythrocytes by fresh tissue.

The details of this work will be published elsewhere.

[1] Blalock, A., *Arch. Surg.*, **20**, 959 (1930).
[2] Nickerson, J. L., *Amer. J. Physiol.*, **144**, 429 (1945).
[3] Ashworth, C. T., Jester, A. W., and Lloyd, G. E., *Amer. J. Physiol.*, **141**, 571 (1944).
[4] Harkins, H. N., *Surgery*, **9**, 231 (1941).
[5] Scott, C., *J. Clin. Invest.*, **25**, 153 (1946).
[6] Wang, S. C., Overman, R. R., Fertig, J. W., Root, W. S., and Gregersen, M. I., *Amer. J. Physiol.*, **148**, 164 (1947).
[7] Rosenthal, S. M., and Tabor, H., *Pub. Health Rep.*, **60**, 373 (1945).
[8] Rosenthal, S. M., and Tabor, H., *Arch. Surg.*, **51**, 244 (1945).
[9] McCarthy, M. D., and Parkins, W. M., *Amer. J. Physiol.*, **150**, 428 (1947).
[10] Fox, C. L., and Baer, H., *Amer. J. Physiol.*, **151**, 155 (1947).
[11] Green, H. N., *Lancet*, ii, 147 (1943).
[12] Rosenthal, S. M., *Pub. Health Rep.*, **58**, 1429 (1943).
[13] Rosenthal, S. M., *Pub. Health Rep.*, **57**, 1923 (1942).
[14] Gregersen, M. I., and Root, W. S., *Amer. J. Physiol.*, **148**, 1 (1947).
[15] Beard, J. W., and Blalock, A., *Arch. Surg.*, **22**, 617 (1931).
[16] Logaras, G. (Univ. of Athens, personal communication).

OBITUARIES

Prof. F. W. Twort, F.R.S.

Prof. Frederick William Twort, who died on March 20 at the age of seventy-two, will rank as one of the major workers in bacteriology on account of his discovery of the bacteriophage.

Born in 1877, the son of Dr. William Henry Twort, he qualified M.R.C.S., L.R.C.P. from St. Thomas's Hospital in 1900. His bacteriological career started forthwith, first in the clinical laboratory at St. Thomas's, then at the London Hospital, and finally, during 1909–44, as superintendent of the Brown Institution, University of London. His first major contribution to bacteriology was the study which he and G. L. Y. Ingram made of the etiology of Johne's disease of cattle. In 1910, they isolated the *Mycobacterium* known as Johne's bacillus by the ingenious method of growing it on a medium containing heat-killed bodies of other acid-fast bacteria. They further showed that the growth-factor present in acid-fast bacilli is widely distributed in other substances such as various fruits, linseed and a fungus; but they were unable to identify it chemically with certainty. Twort also demonstrated allergic reactions in diseased cattle by means of extracts of his cultures, paving the way for the later development of the Johnin test.

The discovery of bacteriophage, or 'bacterial virus', was outstanding. Twort first detected bacteriophage action in colonies of staphylococci isolated from vaccine lymph. He published his first observations in 1915, but was unable to follow them up at once on account of the First World War, in which he served as officer-in-charge of the base laboratories in Salonika and as bacteriologist to the Northern Ireland Command.

Twort at first, and for many years, regarded the nature of bacteriophage as unsettled. He considered from the first the analogy between bacteriophage and viruses, but kept an open mind on the question as to how far the analogy should be pressed, on the evidence then available.

D'Herelle's extensive researches on bacteriophage (for the name of which he was responsible) followed Twort's original discovery in point of time, and d'Herelle's interpretation of the phenomenon from the first corresponded more closely to present-day views; d'Herelle's publications attracted more immediate attention than Twort's first paper had done, so that d'Herelle's name is commonly associated with Twort's in the description of bacteriophage as 'the Twort–d'Herelle' phenomenon. Nevertheless, the priority of discovery was Twort's, and there are some aspects of bacteriophage behaviour which to this day leave open a possibility that the analogy between bacteriophage and virus can be pressed too far.

Twort's contributions to bacteriological science were recognized when in 1929 he was elected a fellow of the Royal Society, and by the conferment of the title of professor of bacteriology in the University of London. He leaves a widow, a son and three daughters.

Prof. R. A. S. Macalister

The death of Prof. R. A. S. Macalister in his eightieth year brings to an end an unusually long, varied and distinguished career of archæological teaching and research. Son of the anatomist, Prof. Alexander Macalister, R. A. S. Macalister entered his

father's College, St. John's College, Cambridge, and graduated in 1892. From the first his interests in archæology were divided between Biblical archæology and the prehistoric and early historic archæology of his native Ireland. He worked under the auspices of the Palestine Exploration Fund and dug at Gezer and elsewhere. From the last decade of the nineteenth century until the mid-twenties of the present century, his excavation and publication were equally divided between Palestinian and Irish archæology; but from the middle twenties onwards he confined himself to the archæology of western Britain and more especially the prehistory and the early Christian monuments of Ireland, where during 1909–42 he held the chair of Celtic archæology at University College, Dublin. Among his main published works were "Studies in Irish Epigraphy" (1897–1907), "A History of Civilization in Palestine" (1912), "The Excavations at Gezer" (1912), "The Philistines" (1913), "The Archæology of Ireland" (1928), and "Tara" (1931). The enumeration of these few from the two dozen or more books which he wrote suffices to indicate the wideness of his interests, his industry and his devotion to the cause of scholarly exposition. His scholarship earned him appropriate recognition in the world of learning; he held senior doctorates of the Universities of Cambridge, Dublin, Glasgow and Wales, and was in his time president of the Royal Irish Academy, the Royal Society of Antiquaries of Ireland, and the Cambrian Archæological Association.

He was, indeed, at the time of his death, unquestionably, the grand old man of Irish archæology. But he did not spend the years of his retirement in Cambridge, from 1942 onwards, in looking back over the record of a long career of original work. He always had several books on hand, and he was busily engaged in writing and revising up to the time of his last illness. He will long be remembered as a teacher, a prodigious worker and an energetic and discursive talker. He was a pioneer of the interpretation of Ireland's past in terms of the comparative archæology of western Europe, and every worker in this field must take his work into account, although his theories were sometimes of an originality which few could follow. Macalister was also a musician of no mean gifts; an associate of the Royal College of Organists, he was for many years organist of a church in Dublin and wrote, among other works, a suite for piano and violin. His humanity, his enthusiasm and his breadth of interests testify to his stature even more than any single contribution to learning.

GLYN E. DANIEL

NEWS and VIEWS

Natural History at St. Andrews: Mr. H. G. Callan

MR. H. G. CALLAN, of the Agricultural Research Council's Animal Breeding and Genetics Research Organisation, has been elected to the chair of natural history in the University of St. Andrews, which has been vacant since the death of the late Sir D'Arcy Thompson. Mr. Callan is one of the brilliant group of zoologists who were trained in Oxford shortly before the Second World War. His own interests have lain mainly in the fields of cytology and marine biology and to the Oxford tradition he has been able to add those of two other world-famous centres of biology —the Stazione Zoologica at Naples and the John Innes Horticultural Institution at Merton. After a few years of work mainly devoted to classical nuclear and chromosomal cytology, Mr. Callan, like so many others, suffered the prolonged interruption of the War, during which he spent five years as a radar officer. In his case, the experience seems not to have been without value for his physiological work, and, since the War, he has been prominent among those who have been applying the new technical devices made available by physics to the study of fundamental biological problems. Selecting the germinal vesicle of the amphibian egg as a suitable material, he has, with the aid of a number of collaborators, attacked the problems of its structure and composition from several different angles. This work, which is not yet fully published, has aroused considerable interest at scientific meetings at which it has been expounded. His colleagues will wish Mr. Callan every success in the opportunities he will now have to develop this most promising and important field of biology.

Engineering at Southampton: Prof. T. R. Cave-Browne-Cave, C.B.E.

WING-COMMANDER T. R. CAVE-BROWNE-CAVE, who retires this summer from the chair of engineering in University College, Southampton, received his early training in the Royal Navy, and served as an engineer officer until 1913. In that year he was seconded to the Royal Naval Air Service, later absorbed into the Royal Air Force, and for the next eighteen years devoted himself to the design, construction and operation of airships. The three non-rigid types, *S.S.*, *Coastal* and *N.S.* (North Sea), which did good service in patrolling the coasts of Great Britain during 1915–18, were designed and built by him and his staff; and he was responsible for the machinery and mooring arrangements of the British rigid airships, until the tragic crash of *R* 101 caused the abandonment of airship construction in Britain. Wing-Commander Cave-Browne-Cave became professor at Southampton in 1931, and the school of engineering has grown sturdily under his direction, including a Department of Aeronautical Engineering which will have its own chair this year. A large range of workshops, a new block of classrooms, and a wind tunnel has been built during his tenure of the chair.

Wing-Commander T. R. Cave-Browne-Cave has also found time and energy for many other interests. Since 1935, he has taken an active part in solving technical problems of noise abatement; and he served during 1938–39 on the committee for structural air-raid precautions of the Ministry of Home Security. On the outbreak of the Second World War, the Royal Air Force claimed him, until in 1941 he was appointed director of camouflage and chairman of the inter-Services camouflage committee; but although away from Southampton most of his time, he was able to supervise, in the College, a number of researches on special problems for the fighting Services. Since the War he has developed a supersonic wind tunnel driven by steam, the cost of which is trifling compared with that of the conventional high-speed tunnels using compressed air; and as a result of a study of the flow of air in motor buses, he has developed a new system of heating and ventilating these vehicles, using warm air from behind the radiator. He has served on the Council of the Institution of Mechanical

Engineers, and on the Southern Regional Council for Further Education; his presidential address to Section G of the British Association in 1948, "The Young Engineer", continues to provoke widespread discussion and approval. Although Wing-Commander Cave-Browne-Cave will soon relinquish the direction of the Engineering Department, the College hopes he will continue his varied researches and, on occasion, delight audiences with a lecture on one of his particular interests.

Mr. A. N. Black

MR. A. N. BLACK, who succeeds Prof. Cave-Browne-Cave, was born in Australia in 1912, and was educated at Farnborough School and Eton College. From there he proceeded to Trinity College, Cambridge, and obtained first-class honours in the Mathematical Tripos, Part I, and in the Mechanical Sciences Tripos (with distinction in applied mechanics). After a year of postgraduate work at Cambridge, studying metallurgy under Prof. R. S. Hutton, Mr. Black went to Oxford in 1935, becoming a lecturer in 1938 and Donald Pollock reader in engineering science in 1946, which post he at present holds. His special interests are computational techniques and the application of statistics to engineering problems; but the Oxford tutorial system requires a tutor in the Engineering Science School to have a knowledge of all branches of the subject. Mr. Black's wide versatility and high ability augur well for the future of engineering at Southampton.

Rochdale Literary and Scientific Society: Dr. J. R. Ashworth

DR. J. R. ASHWORTH, who for the past sixty-five years has been honorary secretary of the Rochdale Literary and Scientific Society, has recently resigned from this office owing to ill health. Dr. Ashworth's membership of the Society dates back to 1883, five years after its inception, and in 1885 he took over the office of honorary secretary from his brother. His devotion to the interests of the Society has been boundless; and his many scientific contacts, through his research and close association with the University of Manchester, his curatorship of the Manchester Literary and Philosophical Society and his chairmanship of the Ancient Monuments Society, have been invaluable in making the Rochdale Society a leading cultural influence in the town and earning for it a high reputation among similar learned societies in Great Britain. Another of Dr. Ashworth's lifelong interests is exemplified by his record of sixty-two years as a co-opted member of the Rochdale Public Libraries Committee. Dr. Ashworth has in the past made a number of contributions to *Nature*, mainly on magnetism and also on atmospheric pollution and its effect on the transmission of ultra-violet radiation. He served on the Council of the National Smoke Abatement Society for many years.

Sir Edward Sharpey-Schafer, F.R.S. (1850–1935)

KNOWN to the public through his method of artificial respiration, Sir Edward Albert Sharpey-Schafer, who was born a century ago, on June 2, 1850, was one of the most original and versatile physiologists of modern times. As a student at University College, London, he came under the influence of William Sharpey, the last professor of general physiology and anatomy, after whom he named his eldest son. When the son fell in the First World War, the father added the name to his own. In 1883 Schafer succeeded Burdon-Sanderson as Jodrell professor of physiology. Sixteen years later he was appointed professor of physiology in the University of Edinburgh, and he occupied this chair until 1933. With Michael Foster he founded the Physiological Society in 1876, and he started the *Quarterly Journal of Experimental Physiology* in 1908. His many original and far-reaching researches included experiments with Victor Horsley on cerebral localization, which advanced the scope of brain surgery; the preparation, with George Oliver, of the first active extracts of the suprarenal and of the pituitary glands; and studies in histology—a subject which he regarded as an essential part of physiology. Numerous honours came his way: fellowship of the Royal Society at the early age of twenty-eight, the presidencies of the British Association (1912) and of the International Physiological Congress (1923), and a knighthood in 1913. Author of "The Essentials of Histology" (1885), "The Endocrine Organs" (1916), and of other physiological classics, Sir Edward Sharpey-Schafer was a fine lecturer, a good administrator, and a charming host. He died at North Berwick on March 29, 1935.

Librarianship in North America

IN the summer of 1947, Mr. J. H. P. Pafford, Goldsmith's Librarian, University of London, visited, on the invitation of the Rockefeller Foundation and the American Library Association, eighty-six libraries, including those of twenty-six universities, and eight library schools in the United States and Canada. The report in which he summarizes the chief points noted (London: Library Association. Pp. vi+43. 4*s*. To members, 3*s*.) is a model of its kind and should be of interest to many besides those concerned with the administration of university libraries. It is necessarily a record of general impressions; but Mr. Pafford comments critically on such matters as the Farmington plan for the acquisition of all foreign literature of importance and its distribution by subjects between many American libraries, the development of depository libraries, buildings and the function of university libraries—topics which are regarded as of main interest at present in American university librarianship. His observations on book selection and reading rooms—particularly in relation to the functions and development of university libraries, and when allowance is made for the text-book position in Great Britain—are a valuable contribution to discussions which must take place on the expansion of British university libraries. On library training, Mr. Pafford writes with discernment, and, although he notes that in the United States library work is recognized as important and valuable by the community, his observations on training and qualifications lend no support to the view that there is anything approaching a library science in the sense of an academic discipline. Brief as it is, this record is of interest not only as a comparison of standards and practice, but also for the realism which its constructive criticism and suggestions should bring to the discussion of matters in which prejudice and tradition rather than clear thinking have frequently been the vogue.

Museums and the School

THE subject of co-operation between museums and schools is one that has of late received much attention and is given prominence in the December 1949 issue of the *Museums Journal*. A distinction is made between children's museums and children in museums.

Although the former is possible in such centres as the Geffrye Museum, London, the latter policy is desirable, and indeed practicable, in the majority of the museums in Great Britain. There is also a difference—although they have much in common—between a schools service based on a museum, as at Leicester, and one administered independently of a museum or art gallery, as in Derby. The papers in the *Journal* all stress the importance of the essential objective quality of museums. They are a branch of public service entirely devoted to the three-dimensional method of presentation—the actual object is the all-important unit. The slightest tendency to use museums simply as additional classrooms must be guarded against with vigilance.

Birds and the B.B.C.

In an interesting article in the *Magazine of the Royal Zoological Society of Scotland* (2, No. 2), Major the Hon. H. Douglas-Home describes the technical preparations which are necessary before broadcasts of birdsong can be made. There are three ways of broadcasting bird songs: by direct transmission from a B.B.C. wireless car, by land line to the B.B.C. studio, and by recording the songs on disks with a B.B.C. mobile recording unit. Direct transmission has been used recently for broadcasting the nightingale from a wood in Kent. The transmitting van arrives the day before the broadcast in a field outside the wood, perfects its short-wave contact with its receiving station some miles away and sets up a control hut between the wood and the van. The transmitting van is thus connected to the control hut, and from the hut four or five cables, each with a microphone at the end, run like spokes of a wheel to selected places in the wood. The commentator is connected to the control hut and directs the engineer which microphone to switch on. It is thus possible to switch to each bird position by turning a knob inside the control hut without having to disturb the songsters by trying to keep near the microphone on each occasion. In the second method of broadcasting, the lay-out of the microphones and the control hut is the same, but the cable from the hut is joined to a land line which connects up with a B.B.C. transmitting station. The uncertainty of these methods, however, necessitates the use of recorded effects on cellulose disks which can be broadcast at any time. The recording apparatus fits neatly inside a saloon car and looks like a radiogram, while half a mile of cable on drums is stored in the car. Cellulose records are cut on a turntable and can be played back almost immediately.

Skokholm Bird Observatory

Established in 1943, the Skokholm Bird Observatory was formerly a private organisation which was maintained until 1940 by R. M. Lockley and others. It has now been taken over by the West Wales Field Society on a lease granted to the Society by the owner of Skokholm, Col. H. V. Lloyd-Philipps. The island will be managed as a Nature reserve by the West Wales Field Society, and, in scientific co-operation with the Council for the Promotion of Field Studies, the Bird Observatory will be maintained as hitherto. The Council for the Promotion of Field Studies will be responsible for organisation, which will be done from its field study centre at Dale Fort on the mainland opposite. Intending students and visitors should apply for permission to study at the Observatory to the Warden, Dale Fort, Haverfordwest, Pembrokeshire. The West Wales Field Society will publish the annual report of the Observatory.

Catalogue of Thermionic Valves

A printed booklet, entitled "List of Preferred Valves", which is a catalogue of preferred thermionic valves and their characteristics, has been compiled and issued by the Electronics Section of the Scientific Instrument Manufacturers Association of Great Britain, Ltd. (pp. 28; London, 1949; 2*s*. 6*d*.). It is believed that most of the requirements of the scientific instrument industry for the normal types of valves can be met by the types listed, and it is hoped that, by limiting the choice of valves to those recommended, problems in the use of thermionic valves in scientific instruments from the points of view of design, servicing and export conditions may be considerably simplified. Two categories of valves are dealt with, standard-sized and miniature. The standard-sized valves are predominantly those on international octal (I.O.) bases; but a number of British *B4* or *B5* bases are included. For the miniature types it was decided, after careful consideration, to adopt those with *B7G* bases. Wherever possible, valves have been chosen for which alternatives are available from more than one manufacturer or for which there are American equivalents. This should be of considerable assistance in overcoming supply and maintenance difficulties, particularly abroad. Those valves which appear also in the Armed Services list of preferred valves are specially indicated, and it is of interest to note the high proportion of such types. The booklet concludes with three pages of base-connexion diagrams which afford an easy means of identification of the pin connexions and also indicate the internal arrangement adopted for the electrodes. Ample space is provided for additional notes by the user of the booklet.

International Standards and Units of Radioactivity

In a letter to the *Physical Review* (77, 142; Jan. 1950), L. F. Curtiss, R. D. Evans, W. Johnson and G. T. Seaborg refer again to recommendations regarding standards and units of radioactivity (see *Nature*, 158, 373; 1946. 160, 778; 1947. 164, 263; 1949). In November 1947 a joint committee of the Divisions of Chemistry and Chemical Technology and of the Mathematical and Physical Sciences of the United States National Research Council was appointed with L. F. Curtiss as chairman. This committee unanimously recommended that the definitions of the 'curie' and the 'rutherford' be the quantities of any radioactive species (radioisotope) undergoing $3{\cdot}700 \times 10^{10}$ and 10^{6} disintegrations per second respectively, and further recommended the roentgen per hour at one metre (rhm) for the quantitative comparison of radioactive sources emitting gamma-rays for which disintegration-rates cannot be determined. It is now pointed out that the curie is thus effectively divorced from the disintegration-rate of radium, and the arbitrary magnitude assigned to the curie cannot be influenced by any further revisions of the generally accepted disintegration-rate of radium. In addition, it follows that one milligram and one millicurie of radium are now no longer synonymous. The new definition of the curie has been submitted to the Joint Commission on Standards, Units, and Constants of Radioactivity of the International Unions of Chemistry and Physics, for the purposes of obtaining international agreement.

Management Efficiency in Nationalized Undertakings

INTRODUCING his paper on managerial efficiency in nationalized undertakings to the British Institute of Management Conference at Harrogate in November 1949, Mr. I. J. Pitman advocated the setting up of a management research service. This, he said, would be complementary to management and, since it would be advisory and without executive powers, would inevitably enhance management status through which it worked. In the majority of nationalized undertakings, consumer interest is inevitably local and is at present very largely protected by members of Parliament, who put questions to the area boards. Mr. Pitman asked why these questions should not be transferred to the House of Commons, where they could be discussed in their proper place and atmosphere. His proposals were strongly supported by delegates to the conference, and it was recommended that each nationalized industry should set up, or where appropriate fully develop, its own management research division both for the board itself and for its area boards. The paper has now been published and may be obtained from the British Institute of Management, 8 Hill Street, London, W.1.

Cambridge Summer School in Electron Microscopy

A SUMMER school in electron microscopy for those who are, or are about to be, operating the instrument will be held again this year in the Cavendish Laboratory, Cambridge, during July 18–29. The lectures will deal with the fundamental theory and operating principles of the electron microscope, and the various techniques of specimen preparation will be demonstrated and practised. The three leading models of instrument will be used. Forms of application (to be returned by June 5) can be obtained from G. F. Hickson, secretary of the Board of Extra-Mural Studies, Stuart House, Cambridge.

Course in Tropical Hygiene for Planters and Miners

THE Ross Institute of Tropical Hygiene of the London School of Hygiene and Tropical Medicine will be holding its annual course in tropical hygiene for planters and miners during July 24–28. Morning sessions will be devoted to malaria and its control, and in the afternoons other tropical diseases and problems will be dealt with, such as hookworm, bilharzia, nutrition, housing and sanitation, and protection against heat. There is no fee for the course. The names of those proposing to attend should be sent as soon as possible to the organising secretary, L. G. Ponsford, London School of Hygiene and Tropical Medicine, Keppel Street (Gower Street), London, W.C.1, from whom all particulars can be obtained.

Capper Pass Awards for Metallurgy

THE Capper Pass Awards for 1949, which are recommended by a committee on behalf of the Institution of Mining and Metallurgy and of the Institute of Metals, have been won by the following: Messrs. J. Matter and M. Lamourdedieu (Société Centrale des Alliages Légers, Issoire (Puy-de-Dôme), France), £50, jointly, for a paper on "The New Factory of the Société Centrale des Alliages Légers at Issoire (Puy-de-Dôme) for the Working of Light Alloys"; Mr. G. Chad Norris (West African Gold Corporation, Ltd.), £50, for a paper on "Gold Concentration at the Amalgamated Banket Arears Reduction Plant"; Dr. E. Scheuer (International Alloys, Ltd., Aylesbury, Bucks), £50, for a paper on "Modern Billet Casting, with Special Reference to the Solidification Process"; and Messrs. H. L. Talbot (Anglo-American Corporation of South Africa, Ltd.) and H. N. Hepker (Central Research Laboratory, N'Kana, Northern Rhodesia), £50, jointly, for a paper on "Investigations on the Production of Electrolytic Cobalt from a Copper–Cobalt Flotation Concentrate". The money for these Awards has been given by Messrs. Capper Pass and Son, Ltd., Bristol, and is allotted as follows: £100 each year for one or more awards to authors of papers on some aspect of non-ferrous extraction metallurgy submitted to the Institution of Metallurgy; and £100 each year for one or more awards to authors of papers submitted to the Institute of Metals and relating to some process or plant used in the fabrication of non-ferrous metals, contributed by persons engaged full-time in industrial practice. All papers relating to these fields and published in 1950 by either of the two Societies will be considered for the Awards; authors need not be members of either Society and may be resident in any country. Manuscripts should preferably be submitted in duplicate to either the Secretary, Institution of Mining and Metallurgy, Salisbury House, Finsbury Circus, London, E.C.2, or the Secretary, Institute of Metals, 4 Grosvenor Gardens, London, S.W.1, from whom further particulars can be obtained.

Announcements

THE following have been elected honorary fellows of the Royal Aeronautical Society: Mr. R. Blackburn, Sir Richard Fairey, Mr. T. O. M. Sopwith, Dr. M. O'Gorman and Sir Francis McClean.

THE following announcements have recently been made by the University of London: Dr. Helen Makower has been appointed to the University readership in economics with special reference to international trade, and Mr. B. S. Yamey to the University readership in economics with special reference to distribution, both appointments being tenable at the London School of Economics and Political Science; the degree of D.Sc. has been conferred on Mr. C. M. Cawley (Imperial College of Science and Technology) and Mr. A. E. Martin (Queen Mary College).

THE third award of the Oliver Memorial Fund (£50) will be made to a British subject for a notable contribution to the research, organisation or donor aspect of blood transfusion. Applications and suggestions should be sent, before June 30, to the honorary treasurer, Mr. F. W. Mills, National Provincial Bank, Ltd., Holborn Circus, London, E.C.1.

A CONFERENCE on fertility, which will also be the inaugural meeting of a new Society for the Study of Comparative Fertility, will be held at the Zoological Society of London, Regent's Park, London, N.W.8, during June 16–17. Those interested in the Society and those desirous of attending the conference should communicate with Dr. G. I. M. Swyer, Obstetric Hospital, University College Hospital, Huntley Street, London, W.C.1, as soon as possible.

ERRATUM. In the communication "Purification and Crystallization of Q-Enzyme" (*Nature*, April 8, p. 573), par. 2, line 9, for "ionic strength" read "molarity".

DEVELOPMENTS IN METEOROLOGY

CENTENARY CELEBRATIONS OF THE ROYAL METEOROLOGICAL SOCIETY

THE celebrations of the centenary of the Royal Meteorological Society were held, partly in Oxford and partly in London, during the period March 28–April 3, 1950. The centenary meeting of the Society was held in the Society's House at 49 Cromwell Road, South Kensington, on April 3, that day being the actual anniversary of the foundation (see *Nature*, March 25, p. 463). At this meeting the president, Sir Robert Watson-Watt, read the loyal message sent to the Society's patron, H.M. the King, and the gracious reply which His Majesty had sent to the Society. A large number of congratulatory letters received from learned societies in Britain and abroad were read, and the president announced the election, as honorary fellows, of the following eminent meteorologists from overseas: S. K. Banerji (India); R. Bureau (France); H. Ficker (Austria); F. A. Vening Meinesz (Holland); and F. W. Reichelderfer (U.S.A.).

After the presentation of the Buchan and Darton Prizes, the newly founded Hugh Robert Mill Prize was awarded to Dr. Hugh Robert Mill himself; but Dr. Mill died on May 5 before the prize could be conveyed to him. Prof. Vening Meinesz then delivered a centenary address, on the value of meteorology to the community. The considerable attendance from abroad at this meeting, and the warmth of the greetings received from learned societies both at home and abroad, were a source of pride and satisfaction to officers and fellows of the Royal Meteorological Society.

The days preceding the day of the centenary meeting had been devoted to meetings and discussions, the start being made at Oxford on March 28, with a series of symposia which continued up to midday on March 30. Saturday, March 31, was spent in visiting the Meteorological Office, Harrow, in the afternoon, followed in the evening by a conversazione in the Society's rooms, at 49 Cromwell Road, South Kensington. The morning of April 3 was devoted to a visit to the Department of Meteorology, Imperial College of Science and Technology, a large part of the time being devoted to a discussion on atmospheric turbulence. On the evening of the same day was held the final event of the celebrations, a dinner which was very well attended, and was an extremely happy event.

It would be pleasant to record that the symposia had led to an immediate solution of some of the outstanding problems of meteorology; but this we cannot truthfully do. The discussions, which ranged over a wide field of meteorology, will be reproduced in full in a special number of the *Quarterly Journal* to be published during the summer of 1950, and all we shall attempt to do here is present a brief account of those new ideas, put forward in the course of the discussions, which may be of general interest.

In the first symposium, on "Radiation and its Effect on the Troposphere and Lower Stratosphere", Prof. A. Adel, of Arizona State College, described an experimental investigation of the polyatomic radiating and absorbing constituents of the atmosphere. In addition to water vapour, carbon dioxide and ozone, he found that nitrous oxide and methane showed marked radiation and absorption. The computed effective radiating temperature for ozone was found to vary from −35° to −45° C., while that for nitrous oxide had values between 0° and 10° C. showing that while the ozone is mainly at high levels, the nitrous oxide is mainly limited to low levels in the atmosphere. R. M. Goody, of Cambridge, described spectroscopic observations made in aircraft at 30,000 ft., which indicated a total water-vapour content of the air above that level equivalent to about 5×10^{-2} gm./cm.^{2}. Some of Goody's spectral records extended as far as 7 μ.

The second symposium, that on "The Physics of Cloud and Precipitation", was perhaps the most interesting of all. Prof. G. M. B. Dobson, of Oxford, in his introduction, stated that recent investigations have shown that at temperatures down to −15° C. clouds usually consist of supercooled water, while below −41° C. they consist of ice particles, with an intermediate zone of temperatures in which some doubt remains as to what occurs.

Dr. V. J. Schaefer, of the G.E.C. Laboratory, U.S.A., showed a remarkable set of slides illustrating the effects of seeding clouds with solid carbon dioxide or silver iodide. The effect of over-seeding was unexpectedly found to be to inhibit the growth of cloud. The ice crystals formed in a cold chamber were shown to be similar to those taken from natural clouds. B. J. Mason (Imperial College) showed that while existing theories of the growth of crystals give an impossibly slow rate of growth, the application of Frank's dislocation theory gives a satisfactory rate of growth of the crystal in terms of the molecular properties of the crystal and the ambient conditions. He was also able to explain how various ice crystal forms can arise in different types of cloud, dealing especially with the transition from polyhedral to dendritic growth. C. Lafargue (France) described how he found that drops of water or aqueous solutions, suspended on spider threads in air or in oil, froze at a temperature of $-40{\cdot}5° \pm 1{\cdot}5°$ C. when the diameter of the drops did not exceed 20 μ. For large drops the freezing point varied with size and concentration. A. W. Brewer and H. P. Palmer (Oxford) described laboratory studies of the Findeisen ice-splintering process. They found that small splinters of ice are formed when impure water freezes, and when hoar-frost grows. These splinters are probably of great importance in providing nuclei of further ice crystals in a cloud. These observations, taken in conjunction with Mason's application of Frank's theory to the growth of crystals, appear to throw light on the difficulty which has been experienced in finding the nature of the sublimation nuclei in the atmosphere, and the rapidity of the growth of condensation once it has started.

In the symposium on "The Structure of Weather Systems", two widely different views were put forward, Dr. Bleeker (Holland) emphasizing the effect of local heating or cooling of air masses by land and sea, and Prof. C. G. Rossby (Chicago and Stockholm) suggesting that the dynamics of depressions could be largely understood without any consideration of the heat supply.

The same diverging views were advanced in the symposium on "The General Circulation of the Atmosphere". Prof. S. Petterssen (U.S.A.) outlined a theory of the maintenance of the general circulation by vorticity transfer. Dr. E. T. Eady (Imperial

College) showed that the instability of baroclinic motion leads to a continual development of 'eddies', that is, of cyclones and anticyclones, associated with poleward and upward transfer of heat from low levels in low latitudes to high levels in the polar regions, a fundamental result of considerable importance. He also advanced a tentative explanation of the observed eddy-transport of angular momentum.

In the symposium on "Climatic Changes", Prof. K. Faegri (Bergen) pointed out the complexity of palæoclimatological evidence, the growth of trees depending on rainfall *minus* evaporation. He added that, while long-period variations tend to be widespread, the variations of shorter period are in general localized. He considered that the changes shown in the climate of north-western Europe since the last ice age are also shown in the climates of all other regions, in both northern and southern hemispheres. Confirmatory evidence of this was given by several other speakers.

The symposium on "Meteorology and the Community" was opened by Sir Nelson Johnson, director of the Meteorological Office, London, who described the services rendered by the Meteorological Office to a wide range of interests. Sir David Brunt, Imperial College, after outlining some of the ways in which meteorology can help the engineer with forecasts of various kinds, suggested that there are in engineering, and in many other technologies, problems in which the meteorologist can help by applying meteorological methods to their discussion. Such services could be rendered by the individual without the backing of a large organisation. He also pleaded for a thorough survey of river flow in the British Isles. Sir William Gammie Ogg described the repercussions of meteorology on agriculture. He spoke of the effects of excessive rainfall on various types of soil and on the formation of soil, and referred to the effect of weather conditions on the incidence and spread of plant diseases. Other speakers agreed in finding varied interests in which meteorology can help, while N. R. Hagen (U.S.A.) thought that the private consulting meteorologist could perform a useful function.

The discussion on "Atmospheric Turbulence" was opened by Prof. P. A. Sheppard (Imperial College), who directed attention to the difficulty of defining the time-interval over which the mean value of a varying quantity should be taken, and described a new instrumental method of measuring the diffusion of momentum and heat in the atmosphere. He gave a brief account of the measurements of the fluctuations of temperature and humidity in the lowest 10 metres over Lough Neagh, Northern Ireland, during April 1949. He was followed by H. Charnock, who elaborated the question of defining the mean value, and showed other results derived from the Lough Neagh observations. These two speakers indicated a new method of approach to the problem of diffusion by turbulence, namely, that of using specially designed instruments to obtain direct measurements of products of the momentary variations of temperature and other meteorological factors, combining these with an integrating mechanism which will yield arithmetical values for the diffusion of various entities. This indicates the possibility of a considerable advance on the days when discussion of turbulence involved the assumption of a coefficient of eddy diffusivity varying with height in accordance with some simple mathematical relation.

There was general agreement among those who attended the centenary celebrations that the symposia had been of great value in bringing out the widely differing lines of attack on the problems of meteorology which are being followed. It was evident that there is at the present time far greater activity in meteorological research than at any time in the past, and that while final solutions of the problems reviewed were not attained, there was evidence of definite advance in some of the most difficult problems of meteorology.

D. BRUNT

METABOLIC INTERRELATIONS

A CONTINUATION of the reports of the Conferences on Metabolic Aspects of Convalescence, sponsored by the Josiah Macy, Jr. Foundation, New York, has been published in a volume entitled "Metabolic Interrelations"*. The former Conferences originated as "a joint effort to do something useful for the armed services"; they have continued with a gradual swing of interest away from immediate clinical preoccupations towards more academic problems, and this swing is recognized in the change of title.

Although the statement that "Today, to be effective, medical research and practice must embrace data from all the disciplines embracing nuclear physics at one end of the spectrum and cultural anthropology at the other" and the oft-voiced plea for inter-disciplinary co-operation are entirely praiseworthy, it may be questioned whether the publication of more or less verbatim reports of impromptu discussions on ordinary papers is of much value. Re-circulation of papers and careful editing of discussions, allowing second thoughts, may indeed lead to a useful product; but questions, referring to details of technique, which could have been eliminated by more careful preparation of papers, and unanswered questions (one series ends plaintively, "What is the adrenal N hormone?") serve to exasperate rather than to enlighten the reader. One feels that such discussions were probably of great value to the participants, and that such conferences do indeed further co-operation, particularly of those vitally interested in this field; but revision and publication through existing journals would be of more use to the scientific community than presentation in this semi-digested state.

The nineteen papers presented comprise seven on various aspects of bone and cartilage metabolism, one study on carbon-14 distribution after its continuous administration, two on gastric secretion, two on isotopic studies of intermediary metabolism, six on steroid metabolism (including two clinical papers on adrenocorticotrophin) and a speculative paper on intracellular energy transfer. A good deal of the material has been published elsewhere.

In the field of bone and cartilage metabolism, A. B. Gutman and T. F. Yü show that *in vitro* calcification of epiphysis slices is inhibited by inhibitors of glycolysis and phosphorylation when the substrate is a solution of calcium phosphate, and that the inhibition is at least partly reversed by adding glucose-1-phosphate, fructose-1,6-diphosphate or 3-phosphoglycerate. Phosphate was rapidly split from adenosinetriphosphate, but no calcification resulted.

* Metabolic Interrelations. Transactions of the First Conference, New York, February 7–8, 1949. Edited by Dr. Edward C. Reifenstein, jun. Pp. 193. (New York: Josiah Macy, Jr. Foundation, 1949.) 2.95 dollars.

R. H. Follis, jun., describes histochemical work which has mainly been published[1], and with M. D. Levine describes a lecithinase in fœtal pig cartilage homogenates which splits lecithin. They find that neutral fat and water-soluble phosphate are formed, the latter being presumed to arise by the action of phosphatase on phosphocholine. Levine, P. S. Rubin, Follis and J. E. Howard show by means of the toluidine blue metachromatic reaction, the periodic acid – leucofuchsin reaction and the silver staining of calcium salts that the granular material deposited in subcutaneous tissue of a patient with calcinosis universalis consists of calcium salts held in a matrix identical in staining properties with calcified cartilage matrix. They also report similar studies on cartilage and bone.

The evidence of isotope work relating to exchange of calcium and phosphorus between bone salt and solution is reviewed by H. C. Hodge, and R. I. Lienke, G. Cullen and W. D. Armstrong describe the distribution of calcium-45 after continuous intraperitoneal administration of $^{45}CaCl_2$ to rats. With the same technique Armstrong and S. H. Zbarsky examine the distribution of carbon-14 after giving $Na_2{}^{14}CO_3$ continuously to a rat for 117 hours. Armstrong and J. Schubert[2] show that "the greater part of ^{14}C deposited in bone is fairly rapidly removed".

On the subject of gastric secretion, C. F. Code, C. M. Blackburn, G. B. Livermore, jun., and H. V. Ratke describe a procedure for assaying inhibition of gastric secretion in the dog, and with it have found inhibitory activity in extracts of hog gastric mucin, in human gastric juice[3] and in saliva. W. B. Patterson and D. Stetten, jun., put forward the hypothesis that gastric mucosa produces a hydrogen-ion gradient by means of a stratification of the various respiratory enzymes across the cell, with dehydrogenases toward the surface and cytochrome oxidase and carbonic anhydrase toward the blood supply.

Energy transfer is considered by O. H. Schmitt, who suggests very plausibly as an alternative to high-energy phosphate bonds as carriers that energy is transferred and stored within the cell in the form of electrostatic potential gradients at interfaces. His objection to coupled reactions on the grounds that they involve multi-body collisions seems, however, rather thin, since many such reactions are known to occur at reasonable rates[4].

In the discussion on intermediary metabolism, H. G. Wood shows that, on giving to fasted rats formate labelled with carbon-14 and glycine labelled with carbon-13 in the carboxyl radical, the isotope distribution in the liver glycogen formed supports the hypothesis[5] that these substances form serine, which then goes to glycogen via pyruvate. Serine isolated from the liver protein also shows the expected isotope distribution. S. Gurin describes isotope experiments, with phenylalanine labelled in either the side-chain or the ring, which confirm that the side-chain shifts during metabolism and that a carbon atom from the ring becomes the γ carbon of the acetoacetate formed. Leucine is similarly shown to form acetone and two-carbon fragments.

Finally, there are the papers on steroid metabolism. F. Albright and his collaborators show that on giving adrenocorticotrophin to patients there is a marked transitory potassium excretion, and an excessive retention of sodium suggesting its entry into cells. There is also a steady loss of nitrogen without commensurate loss of phosphorus and potassium; it is suggested that the retention of the latter is associated with glycogen retention. L. Wilkins and R. A. Lewis find that adrenocorticotrophin given to patients with Cushing's syndrome has much the same effect as in normal persons, whereas in cases of adreno-genital syndrome it causes marked sodium and chlorine loss and some loss in weight; they suggest that the adrenals may secrete a hormone causing salt loss. In another paper they discuss the effect of various testosterone derivatives on adrenal weight and cholesterol content. Methods of estimating urinary corticoid activity are compared by E. H. Venning; and D. K. Halvorsen describes the effect of sex hormones on muscle and bone tissue atrophy in the hind limbs of mice paralysed by spinal cord hemisection, and on bone total and ash weights when given throughout the life of mice. R. PEARCY

[1] Follis, R. H., jun., and Berthrong, M., *Amer. J. Path.*, **24**, 685 (1948).
[2] Schubert, J., and Armstrong, W. D., *J. Biol. Chem.*, **177**, 521 (1949).
[3] Brunschwig, A., *et al.*, *J. Clin. Invest.*, **18**, 415 (1939).
[4] Dixon, M., "Multi-Enzyme Systems" (Cambridge University Press, 1949).
[5] Sakami, W., *J. Biol. Chem.*, **176**, 995 (1948).

WATTLE RESEARCH INSTITUTE, SOUTH AFRICA

THE Wattle Research Institute at Pietermaritzburg is a new Institute under three different organisations—the South African Wattle Growers Union, the University of Natal, and the Union Department of Forestry—and it has recently published a first report for 1948*. Since the work of the Institute has scarcely been begun, the publication of a report may appear to be premature; but the time is opportune to place on record details of the conception and development of the idea and its fulfilment.

The constitutional relation of the Institute to the three organisations is also of interest to study. The idea was started some time about 1937, when a number of growers, under the stimulus of discussions with the research officers of the Department of Forestry, began to take an interest in the idea of such an Institute. It was felt that the importance of the industry merited the establishment of a research organisation devoted exclusively to the improvement of wattle cultivation and tannin production and into which all the various lines of research on wattle could be gathered as a co-ordinated whole.

The opening phases of the establishment of this important Research Institute are curiously like those followed when the great Forest Research Institute at Dehra Dun, India, was first commenced in 1906–7.

As is stated in the foreword of this report, "The research programme presented is of a tentative and very fluid nature designed only to crystallize early ideas. It will be modified and extended as necessary when the various lines of work open out and take shape and as new problems become apparent." That is the way the research officers began their operations at Dehra Dun. Even during the First World War the Government of India soon recognized its great usefulness, and, before the Second World War broke out, a mighty research organisation had been built up. Let us hope that a similar record of successful expansion and progress will be the lot of the Wattle Research Institute in South Africa.

* University of Natal: Wattle Research Institute. Report for 1948. Pp. 26. (Pietermaritzburg: Wattle Research Institute, 1948.)

EFFECT OF VERNALIZATION AND PHOTOPERIODIC TREATMENTS ON GROWTH AND DEVELOPMENT OF WHEAT

By Dr. J. J. CHINOY
Botany Department, University of Delhi

In previous communications[1,2,3], yield and growth analysis of a large number of genotypes of wheat, differing widely in their time of flowering, were reported. Over and above establishing highly significant negative correlations between temperature of the ripening period and yield as well as 1,000-corn weight, it was also demonstrated that growth as measured by tiller production, height, and leaf and stem dry weights was greatly influenced by the time of flowering of a variety. In fact, varieties belonging to different flowering classes were found to conform to a definite growth pattern for that class.

The above-mentioned results have been further confirmed by carrying out complex experiments involving different combinations of vernalization and photoperiodic treatments of wheat varieties belonging to different flowering classes*. Methods of growth analysis suggested by Gregory[4] have been made use of in studying the growth of these varieties. A mention has already been made of one such experiment with reference to the 'photo-requirement' of these varieties[3]. As the data are very extensive and as the purpose of this note is to make a preliminary report of this important finding, data of tiller production, height, and leaf and stem dry weights for only one of the twelve varieties—Cambridge Rivett (*Triticum turgidum*)—used for that experiment[3] are reported here.

Experimental Results

It will appear from the accompanying graphs that tiller production is considerably reduced under the influence of long-day conditions, probably due to the earlier onset of the reproductive phase. It is also considerably reduced under short-day treatment owing to a very large reduction in carbon assimilation. This is shown by the very low rate of net assimilation in plants under short-day conditions (unpublished data). This result is further supported by the fact that when plants are transferred from short to normal days (after eighty-five days) tiller production is increased. The important fact that emerges from these data is that when the developmental process of wheat is accelerated under the influence of vernalization and long-day treatments tiller production is reduced. In other words, if a late variety is made early, its tiller production will be reduced to the same level as ordinarily found in any of the early varieties.

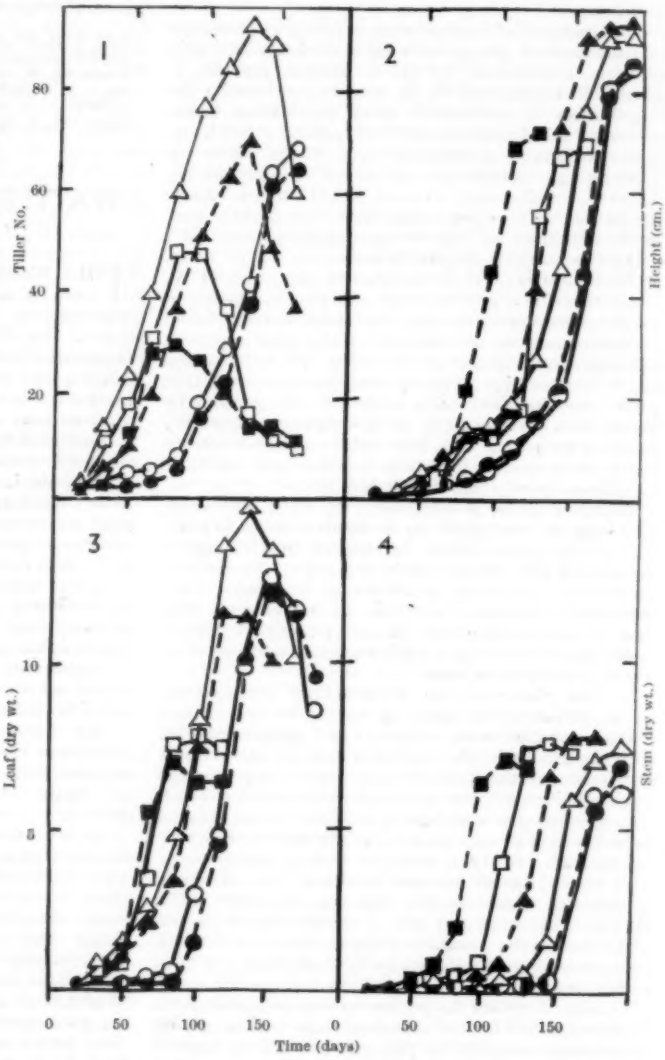


Fig. 1. Graphs of (1) tiller production; (2) height; (3) leaf, dry wt.; (4) stem, dry wt.: of Cambridge Rivett, under six vernalization and photo-periodic treatments. □, Long day, continuous illumination, unvernalized plants; ■, long day, continuous illumination, vernalized plants; △, normal day, continuous illumination, unvernalized plants; ▲, normal day, vernalized plants; ○, short day (six-hour day), continuous illumination, unvernalized plants; ●, short day (six-hour day), vernalized plants

* This work was done in the Division of Botany, Indian Agricultural Research Institute, New Delhi.

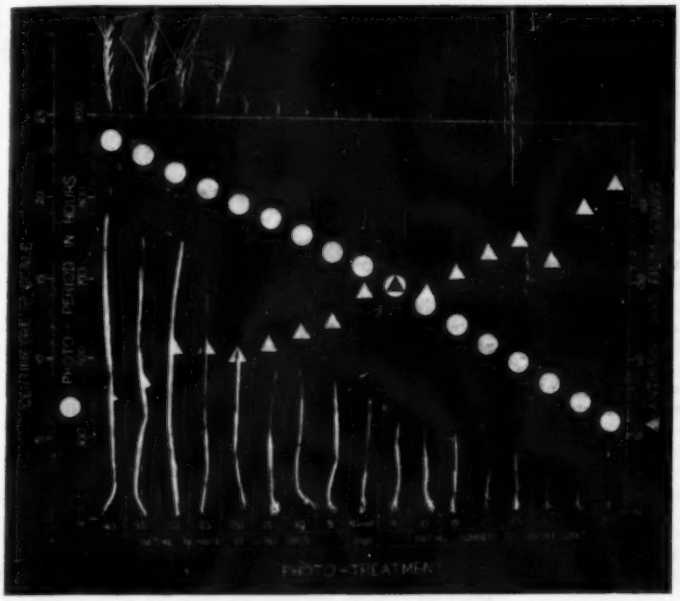


Fig. 2. Relation between stem growth, spike development and flowering of *N.P.* 52 under seventeen different photo-periodic treatments

as already reported. The results of leaf dry weights also corroborate these findings. With acceleration in time of flowering, total leaf dry weight as well as number of leaves on the main stem are reduced. The result of height and stem dry weight also reveal correlation with flowering as shown by growth analysis of wheat varieties (Graphs 2 and 4 respectively of Fig. 1). It is obvious that, by hastening the time of flowering, stem elongation starts earlier (long-day, vernalized), and by delaying the onset of flowering (short-day, unvernalized, and short-day, vernalized) stem growth is retarded for a longer period. Almost identical conclusions can be arrived at from the results of stem dry weights.

This fact is further corroborated by the results of another experiment where a large number of photo-periodic treatments were given to one variety (*N.P.* 52). There were in all seventeen light treatments. In the eight long-day treatments continuous illumination was given for 5, 10, 15, 20, 25, 30, 35 and 40 days after germination by supplementing the natural light with artificial illumination at night. Normal-day treatment consisted of the full daily period of natural illumination; and the eight short-day treatments received diurnal illumination of six hours for 5, 10, 15, 20, 25, 30, 35 and 40 days after germination, by screening off the light for the rest of the day. Stems were dissected out on the sixty-fifth day after germination. With increasing amount of light, acceleration in stem growth takes place and with reduction in the amount of light, retardation in stem growth takes place. With descending order of magnitude of light treatments the stem-lengths also show a progressive decline, until in the last light treatment (forty short-days) there is scarcely any stem elongation visible. Similarly there is a very close correspondence between the growth of the spike and the stem growth. Dissected spikes for each light treatment are shown at the top of the photograph (Fig. 2). There was also a progressive decline in the size of the spike. Triangles give the vegetative periods of plants under each light treatment, and white disks the amount of light received by the plant in hours of sunlight, during sixty-five days of growth. Correlations between time of flowering, photoperiod, stem growth and spike development are so clear that no further comments are necessary.

It is worthy of note that plants of the same variety conform to the growth-pattern of an early or a late variety under different light treatments.

Discussion

From the foregoing it appears that any alterations in the rate of the developmental process brought about as a result of vernalization and photoperiodic treatments changes the whole growth pattern of the plant. The change, however, is in different phases and components of growth, such as dry weights of leaf and stem, leaf and tiller numbers, etc., and not so much in its total magnitude, because it has been observed that relative growth-rates of different wheat varieties do no change appreciably with the time of flowering.

These facts are very suggestive. As already found[3], there appears to be a quantitative difference in the photosensitivity of the genic complex determining the developmental process in different varieties. In an early variety the available nutrient supply is utilized for the early growth of stem which is necessary in the case of wheat as it is terminated by a reproductive spike. This early development of stem and spike puts a brake on tiller production, leaf number and leaf dry weight in an early variety. In a late variety the available nutrients of the soil are used for tiller production for a longer time. As a consequence of this, the total leaf dry weight as well as number of leaves on the main stem are greater than in the case of an early variety. Stem elongation can only start with a change in the growing point from purely vegetative to reproductive function, and this change is progressively delayed with lateness in flowering. Abnormalities in growth behaviour of wheat varieties have not been observed so far. For example, an early variety has not been found to tiller more profusely or have a greater number of leaves on the main stem than a late variety; and stem elongation in a late variety has never been found to occur before that in an early variety. This close affinity of the growth pattern of wheat to its developmental process suggests an equally close affinity in their inheritance. In fact, a suggestion may be hazarded that the genic complex controlling the developmental process in wheat also determines the magnitude and the pattern of growth, and that at least for some of the major growth processes there are no separate genes.

[1] Chinoy, J. J., *Nature*, **159**, 442 (1947).
[2] Chinoy, J. J., *Nature*, **164**, 879 (1949).
[3] Chinoy, J. J. (unpublished records).
[4] Gregory, F. G., *Ann. Bot.*, **40**, 1 (1926).

SEROLOGICAL BEHAVIOUR OF HUMAN AND HOG *H*-SUBSTANCES WITH THE SO-CALLED ANTI-*O* SERA OF DIFFERENT ORIGIN

By E. F. ANNISON and Dr. W. T. J. MORGAN, F.R.S.
Lister Institute of Preventive Medicine, London, S.W.1

SCHIFF[1] and Greenfield[2] first introduced the use of selected normal cattle sera which, after suitable absorption with A_1B cells, act as useful reagents for the agglutination of human group *O* red-cells. Somewhat later, an antiserum produced in the goat[3] by immunization with a culture of *Shigella shigæ* and afterwards absorbed with A_1B cells was also employed for this purpose, and more recently the sera of rabbits immunized with a preparation of human *H*-substance (the so-called *O*-substance), derived from a person of blood group *O*, were also found to be valuable reagents for the detection of *O* cells[4]. The normal serum of some specimens of the eel *Anguilla anguilla*[5], an *O*-cell agglutinin induced in chickens by immunization with a suspension of *Shigella shigæ*[3], and certain human sera[7] have been likewise employed in blood-group studies as reagents which bring about the agglutination of group *O* cells.

The ubiquitous nature of sera which agglutinate group *O* cells might well lead one to expect that a considerable variation in the closeness of serological fit would be revealed when they are employed under identical conditions as test sera for the determination of the relative activity of human or animal *H*-substances.

The different sera which bring about the agglutination of *O* cells strongly, while agglutinating cells belonging to other blood groups less readily or not at all, have been loosely referred to in the literature as 'anti-*O*' reagents. These sera are considered by some to be specific for a product of Bernstein's *O* gene, and to be suitable for differentiating homozygous (*AA*, *BB*) from heterozygous (*AO*, *BO*) cells[8]. It is now recognized[9], however, that they detect a substance which is not related serologically to that derived from Bernstein's group *O* gene. It would appear that these sera detect a material which is present to a variable extent on the surface of the majority of erythrocytes and is likewise found in the secretions of persons irrespective of their *ABO* blood group. A material believed, on the basis of its reactivity with a true anti-*O* serum[7], to be a product of Bernstein's *O* gene has now been obtained[10] from group *O* erythrocytes and is found to be readily distinguishable serologically from the so-called *O*-substance described in the literature. In order to avoid confusion, therefore, it has been suggested[11] that the latter substance should be called '*H*-substance' instead of *O*-substance. The designation *H*-substance serves to indicate its heterogenetic and ubiquitous nature, to emphasize that it is not a product of the *O* gene, and to establish that it is immunologically distinct from the substance on the erythrocyte surface which reacts with true anti-*O* sera, that is, with those sera which react with a product of the *O* gene.

During the course of an investigation on the nature of *H*-substances of human and animal origin[11], we have observed that preparations of these substances possess serological activities which vary greatly in intensity according to the antibody employed to measure the activity. When materials which are essentially homogeneous on the basis of physical, chemical and immunological evidence became available, they were titrated for activity under strictly standardized conditions with all the above-mentioned reagents which agglutinate group *O* cells. Approximately the same amount of each agglutinin was employed, an amount which gave firm agglutination of *O* cells and represented two to three completely agglutinating doses. The titre of each serum reagent, tested against freshly drawn *O* cells, was 16–32 after the tests had stood for two hours at 14–16°. A_1B cells remained unagglutinated with the test-dose of serum. Two preparations of human *H*-substance isolated from different ovarian cyst fluids, together with four specimens (three kindly supplied by Dr. E. A. Kabat, of New York) of *H*-substance derived from individual hog stomach linings, were tested for their capacity to inhibit the agglutination of *O* cells by the different sera. The substances were tested over a range of concentrations from 10 mgm. per ml. to 0·005 mgm. per ml.

The results are summarized in the accompanying table. The two preparations of human *H*-substance examined behaved alike with each test reagent; and similarly, there appeared to be no significant qualitative difference in the serological behaviour of each of the four specimens of hog *H*-substance with any one reagent. The reactivity of the substances with each serum is expressed as the greatest dilution of the substance required to give almost complete inhibition of the agglutinating action of the test-dose of serum on group *O* cells. In each instance this dilution of the human *H*-substance is arbitrarily entered in the second column under each serum heading as 100 per cent activity, and the corresponding dilution of the hog *H*-substance is expressed in terms of the activity of the human substance. The inhibition titres of the human and hog *H*-substances are comparable only when obtained with a single 'anti-*O*' reagent. Thus it is seen that when human anti-*H* serum is employed, human *H*-substance shows inhibition at a dilution of $1 : 1 \times 10^3$, whereas the hog *H*-substance, tested under identical conditions, shows an inhibition end-point at a dilution of only $1 : 4 \times 10^2$. A second human anti-*H* serum gave almost identical results. The same serial dilutions of each of the *H*-substances when titrated against several rabbit anti-human *H*-substance sera, however, show a more comparable inhibition end-point; but nevertheless the hog *H*-substance is found to possess in each instance not more than a quarter of the activity of the human *H*-substance.

Corresponding tests which employed natural eel serum as the agglutinating agent revealed that with each of eight specimens of serum the hog *H*-material is distinctly *more* active as an inhibitor of the agglutination of *O* cells than is the human *H*-substance. Similar tests with a single specimen of chicken serum and with four samples of normal cow

INHIBITION END-POINTS GIVEN BY (a) HUMAN AND (b) HOG *H*-SUBSTANCE WITH THE SO-CALLED ANTI-*O* SERA OF DIFFERENT ORIGIN

Origin of *H*-substance	Human serum (2*)		Immune rabbit (6*) (*v*-human *H*-substance)		Natural eel serum (8*)		Immune chicken serum (1*) (*v Shigella shigæ*)		Immune goat serum (1*) (*v Shigella shigæ*)		Natural cow serum (4*)	
	Titre	Activity	Titre	Activity	Titre	Activity	Titre	Activity	Titre	Activity	Titre	Activity
Human	1×10^6	100%	1×10^6	100%	1×10^4	100%	8×10^3	100%	3×10^3	100%	16×10^3	100%
Hog	4×10^3	0·4%	256×10^3	25%	4×10^4	400%	128×10^3	1600%	3×10^3	100%	128×10^3	800%

* Number of specimens examined

serum gave similar results, hog *H*-substance being a more potent inhibitor of *O*-cell agglutination with these reagents than is the human *H*-substance. The single specimen of goat serum tested, although giving strong agglutination of *O* cells at a dilution of 1 : 100, is nevertheless poorly inhibited by both human and animal *H*-substances and must be considered a relatively unsatisfactory reagent for following the course of isolation and purification of these materials from tissues or body fluids.

It is evident from these results that considerable care should be taken in selecting a serum as a standard test reagent for the determination of the *relative* activity of the *H*-substances of human and animal origin. The relative specific activity of the preparations of the human and hog *H*-substances as determined by human or rabbit sera would seemingly be contradicted by results obtained with the corresponding eel, cow or chicken sera. It is evident that each kind of serum possesses its own measure of *H* specific character. The human, rabbit and eel anti-*H* sera combine equally well, as measured by the inhibition titre, with human *H*-substance. The human anti-*H* serum, however, is almost specific for human *H*-substance, and behaves differently with hog *H*-substance, with which it shows poor reactivity. Rabbit, and especially eel, sera, on the other hand, react readily with hog *H*-substance as well as with human *H*-substance. Indeed, it appears that natural eel sera show closer serological fit, and in consequence a stronger affinity, for hog *H*-substance than do any other sera tested. The cow, chicken and goat serum reagents investigated show relatively poor serological affinity for the human *H*-substance. It is to be noted, however, that cow and chicken sera, although reacting weakly with human *H*-substance, show a relatively pronounced and at the same time specific affinity for hog *H*-substance.

The hog *H*-substance was exposed during its isolation from individual stomach linings to prolonged peptic digestion[12], and it was, therefore, conceivable that its original specificity had been modified and that the differences revealed by the serological experiments described arose completely or in part through exposure of the native material to the conditions associated with peptic digestion. Human *H*-substance was accordingly treated with crystalline pepsin under conditions of *p*H, time and temperature similar to those to which the hog *H*-substance was submitted. Subsequent serological examination of the human *H*-substance after this treatment showed it had not developed the serological behaviour recorded in the table for the hog *H*-substance.

The result of these experiments, which have been carried out with essentially homogeneous specific substances, indicate that the human and hog *H*-substances as isolated are not identical, and additional unpublished evidence of a more chemical nature has been obtained which supports this conclusion. Qualitatively, these substances possess a degree of common specificity the quantitative estimate of which varies greatly according to the serological reagent used to measure it. The human, rabbit and eel serum reagents appear to be equally suitable for measuring the activity of preparations of human *H*-substances and are far superior for this purpose to the chicken, cow or goat sera investigated. On the other hand, those natural eel sera which possess an agglutinin for human *O* cells are the most sensitive reagents for measuring the activity of hog *H*-substance.

It is of interest to consider to what extent the different behaviour of the sera examined is influenced by the animal species from which the agglutinin is obtained.

The serological relationships revealed by these preliminary investigations should be confirmed for a wider range of sera where possible by means of the quantitative precipitation techniques developed by Heidelberger[13] and by Kabat[14]. Full details of the experiments described will be published elsewhere as part of a larger investigation on the complexity of the human blood groups.

We acknowledge with thanks specimens of natural eel and immune chicken serum from Dr. R. Grubb, of the University of Lund, and a liberal supply of goat serum from Dr. E. A. Kabat, of New York. One of us (E. F. A.) is indebted to the Medical Research Council for a studentship.

[1] Schiff, F., *Klin. Wchschr.*, **6**, 303 (1927)
[2] Greenfield, G., *Z. Imm. Forsch.*, **58**, 107 (1928).
[3] Eisler, M., *Z. Immun. Forsch.*, **67**, 38 (1930); **73**, 37 (1931); **73**, 392 and 546 (1932).
[4] Morgan, W. T. J., and Van Heyningen, R., *Brit. J. Exp. Path.*, **25**, 5 (1944).
[5] Jonsson, B., *Acta. path. microbiol. Scand.*, Supp. 54, 456 (1944). Grubb, R., *Acta. path. microbiol. Scand.*, Supp. 84 (1949).
[6] Grubb, R., *Acta. path. microbiol. Scand.*, Supp. 84 (1949).
[7] Boorman, K. E., Dodd, B. E., and Gilbey, B. E., *Eugenics*, **14**, 201 (1948). Morgan, W. T. J., and Watkins, W. M., *Brit. J. Exp. Path.*, **29**, 159 (1948).
[8] Matta, O., *Fac. Med. Univ. Egypt*, Pub. No. 11 (1937). Dahr, P., *Z. Immun. Forsch.*, **92**, 180 (1938); *Klin. Wchschr.*, **18**, 471 (1939).
[9] Moreau, P., *Sang*, **9**, 484 (1935); *Rev. d'Hemat.*, **1**, 266 (1946). Lambert, J., *Rev. belge. sci. med.*, **13**, 1 (1941). Witebsky, E., and Klendshoj, N. C., *J. Exper. Med.*, **73**, 655 (1941). Blumenthal, G., and Rasch, L. H., *Z. Immun.*, **103**, 436 (1949).
[10] Morgan, W. T. J., and Watkins, W. M., *Brit. J. Exp. Path.*, **29**, 159 (1948), and unpublished work.
[11] Annison, E. F., and Morgan, W. T. J. (unpublished work).
[12] Aminoff, D., Morgan, W. T. J., and Watkins, W. M., *Nature*, **158**, 879 (1946). See also ref. 14.
[13] Heidelberger, M., and Macpherson, C. F. C., *Science*, **97**, 405 (1943); **98**, 63 (1943).
[14] Kabat, E. A., and Bezer, A. E., *J. Exp. Med.*, **82**, 207 (1945); **83**, 477 (1946).

WELFARE OF ANIMALS IN THE LABORATORY

ALL experimental workers worthy of the name will welcome Major C. W. Hume's pamphlet, entitled "How to Befriend Laboratory Animals", which has been published by the Universities

Federation for Animal Welfare*. The aims of the Federation are well known; it exists to enlist in Great Britain the influence of university men and women on behalf of the humane treatment of animals, wild and domestic; to promote interest in this at home and abroad; to lessen the pain and fear inflicted upon animals by man; to obtain and disseminate accurate knowledge relating to the welfare of animals; and to promote legis ation for their humane treatment. It is noteworthy that the welfare of all animals is included in this charter and that accuracy of the knowledge disseminated is a primary aim.

In this pamphlet, the sanity of which will commend it to a wide circle of readers, Major Hume outlines the history of the use of animals for experimental work and the development of the movement against vivisection. He gives—all too briefly, some will think—the reasons why experiments upon animals are made, states the risks to which the animals are exposed and estimates how much laboratory animals suffer in Great Britain and elsewhere. Then follows a section, written with all the author's knowledge and experience, about the ethics of a problem which is never absent from the minds of experimental workers. The criterion by which the experimental worker should decide whether or not experiments upon animals are justified is, suggests Major Hume, the question: "Should I myself be willing to endure that degree of suffering in order to attain the object in view?" If, says Major Hume, the answer is "No", then the animals must not be used. Great Britain, he goes on to say, has "no little reason to be proud of the way she has handled the problem of animal experimentation", but improvement is, as everyone will agree, always possible. Major Hume suggests that many more Home Office vivisection inspectors are needed for the promotion of a uniform standard of humane treatment. Existing precedents should be constantly reviewed in relation to the pain rule, and zoologists, veterinarians and judicious animal-protectionists should be consulted more often. The less popular species of animals need specially considerate attention.

Dr. F. J. Vinter, the secretary of the Federation, has suggested that experiments should be classified according to the degree of their severity into four or five categories; instead of the present system of licences accompanied by certificates which extend the work permitted by the licences alone, there should be licences graded according to the categories of the severity of the experiments, and licences for work which inflicts pain or comes into the more severe categories should be progressively more difficult to obtain. Among other improvements suggested by Major Hume are medals for distinguished service in animal rooms, centralization of the breeding and supply of laboratory animals (a development which is already in progress) and better animal accommodation. Work on the psychology of the animals and further study of the techniques of anæsthesia and euthanasia are also desirable.

This pamphlet should be widely read. It is essential that accurate knowledge of all the controls that nowadays govern the use of animals for experimental work should be disseminated as widely as possible.

G. LAPAGE

* How to Befriend Animals. By Major C. W. Hume. Pp. 1–12. (The Universities Federation for Animal Welfare, 284 Regent's Park, London, N.3, 1949.) 3d.

CARNEGIE TRUST FOR THE UNIVERSITIES OF SCOTLAND

ANNUAL REPORT FOR 1948–49

THE forty-eighth annual report of the Carnegie Trust for the Universities of Scotland for the year 1948–49* points out that, since, so far as the large majority of Scottish students is concerned, the sums devoted in the past towards payment of fees are no longer required, the time has come when the Trustees must consider how they can employ the consequent surplus most advantageously for the Scottish universities. In addition to the sum of £54,100 under the quinquennial allocation for the year, £26,820 was devoted to a wide variety of objects in furtherance of postgraduate study and research, and it is considered that all the signs point to a steady increase in the needs of postgraduate study and research schemes, the fostering of which the Executive Committee regards as one of its most important and valuable functions. In addition to the increased fellowship, scholarship and grant scheme and subventions to the universities for purposes of travel and maintenance of university staffs engaged in research, the report refers to increased assistance given in the purchase of instruments and apparatus for specific pieces of research, to guarantees on a large scale against loss on the publication of books of outstanding merit which by their nature are not likely to have large sales, and to assistance to learned societies in Scotland in the publication of transactions. The Executive Committee proposes also to give increased assistance to students about to go on to advanced studies.

In the report upon the work of investigators under the research scheme during the year, which is appended, reference is made to Dr. T. S. Hutchison's study of the effect of cold working on the magnetic properties of pure metals, and Mr. F. B. Stern's work on the X-ray analysis of single crystals. Mr. J. H. Robertson has continued his X-ray investigation of the molecular configuration of strychnine, Mr. W. E. F. Naismith has completed a study of the optical properties of the chloro-nitroso compound previously synthesized and resolved, and Mr. K. C. Reid has made good progress with his investigation of the furyl analogues of benzoin derivatives. Progress is also reported in Mr. S. V. Ruff's work on α-amarin, a constituent of elemi resin, in Mrs. N. F. Storey and Miss B. Cairns' search for new antimalarial compounds, by the synthesis of benzacridines, benzcarbolines and quinoquinolines, and in Mr. W. H. Stafford's syntheses in the fluorenone series. In medicine the outstanding feature is Dr. Z. Godlowski's investigation on the location of the allergic reaction by the use of radioactive isotopes. Mr. J. B. Wilson has investigated amino-acid absorption from mammalian gut, Miss M. E. Rowatt the metabolism of *Lactobacillus plantarum*, and Dr. C. C. Forsyth the dietetic treatment of diabetes mellitus. Dr. E. Reid has continued his work on the diabetogenic principle of the anterior pituitary body and has found a satisfactory method of obtaining essentially pure preparations of the hormone, which he has shown to consist predominantly of a single protein. Dr. D. C. Gibb has continued her study of the unattached seaweed *Ascophyllum mackaii*, and

* Carnegie Trust for the Universities of Scotland. Forty-eighth Annual Report (for the Year 1948–49) submitted by the Executive Committee to the Trustees on 27th February 1950. Pp. iv+68. (Edinburgh: Carnegie Trust for the Universities of Scotland, 1950.)

has shown that it is a form of the attached species, while Dr. J. D. Robertson's work on the chemistry of the body fluids in octopus and squids has shown that the 'kidney' of these animals may have an important role in maintaining the relative levels of different metals in their bodies.

In geography and geology the researches were mainly geological but covered a very wide range. Particular reference is made to surveys of the geology of the Elburz Mountains, north-east of Teheran, by Sir Edward Bailey, and of the geology of Ubekandt Island in West Greenland, by Dr. H. I. Drever. Work on the spores of recent and fossil microspores in archegoniate plants has been continued by Mrs. E. A. Knox, and special mention is made of excavations carried out at Kafizin, Cyprus, by Mr. T. B. Mitford, leading to the collection for the Cyprus Museum of some five hundred inscribed sherds.

The report of the superintendent of the laboratory of the Royal College of Physicians, also appended, refers to the death of Dr. R. C. Low, who had been curator and superintendent since January 1, 1945, as well as to the loss of Dr. W. O. Kermack, head of the Biochemical Department, on taking up his appointment as professor of biological chemistry in the University of Aberdeen (see *Nature*, 162, 604; 1948). Drs. J. C. Lees and W. W. Park have published the report of a study of the histological appearances of cancer at different ages and are preparing a review of the pathology of the cancer of the thyroid, while Drs. T. W. Lees and J. C. Lees have submitted for publication a report of a comparison between the lethal doses and the tumour-inhibiting doses in mice of several drugs. Dr. E. K. Dawson continued her histological investigations and completed a third study of sarcoidosis. Workers in the Chemistry Department of the College were occupied chiefly in completing the synthesis of compounds of possible chemotherapeutic activity, with special reference to malaria, filariasis and amœbiasis. 4-Diethylpropylamino-*p*-phenanthroline has now shown considerable activity in tests on chicks infected with *P. gallinaceum*, but some benzthiazole derivatives proved inactive against filarial infections of cotton-rats. Mrs. Storey and Miss Cairns completed their researches on benzcarbolines and quinoquinolines, and on azanthracenes and linear benzacridines, respectively, and Dr. Miller his study of the chloride content and electrical conductivity of human milk.

JOHN HANSON: A MAKER OF MICROSCOPE SLIDES

THE history of the development of science in Great Britain abounds with the names of many whose training did not embrace all that is usually considered necessary for the professional scholar. Some had a sound early education, some were entirely self-taught. Some, such as Landen, remained 'amateurs' throughout their lives, while others, such as Thomas Simson, achieved professional status by their sole efforts.

From scientific correspondences to be found in such periodicals as the *Gentleman's Magazine* and the *Lady's Magazine* and from the minutes of old-founded local societies, one can conclude that there were many others who by example and interest and by occasional positive contributions have helped in the development. There are also men who have been similarly active but who, through the circumstances of their positions, have not been fortunate enough to have had any record made, published or unpublished, of their interests. The gradual tabulation of the men of both these classes and of their interests would be a valuable adjunct to the lists of the work and achievements of the 'known' students of science. It could well be done by the individual inquiries of the trained men and women spread over the country in the teaching profession.

John Hanson, of the West Riding of Yorkshire, is one who falls into the latter group, and, although his death is as recent as 1890, his singular self-taught ability in the manufacture of slides for the microscope is already forgotten. His early days were spent working on a farm at Crossland Moor, near Huddersfield, where an interest in matters theological is perpetuated by his endorsement "John Hanson's, Crossland Moor, 1853" in "An Exposition to the Creed" by John Pearson, D.D. The volume bears a large number of marginal notes in a shorthand of his own devising. A kick on the chest by a horse, which affected his breathing throughout the rest of his life, forced him to a less strenuous occupation, and he moved to the Leeds area. On July 3, 1853, and on April 9, 1854, he preached three sermons at the Muff Field Chapel, Bradford, of the Wesleyan Reform Movement, and became full minister of this Chapel and of the Park Lane Chapel of the same town, in 1860, resigning in 1866. It is from the recollections of a former member of this Chapel, now elderly, who was in contact with John Hanson for the last twenty years of his life, and from the scanty records of the Chapel, that the information in this article has in the main been drawn. He is remembered as a big powerful man with a clear speech, though somewhat laboured from his injury, and with a strongly revivalistic style. His biological and botanical studies were already prominent, and, on his leaving, members of his pastorate, subscribing twenty guineas, presented him with a Beck microscope. This microscope with its equipment and some of his own slides was until recently in good condition; it met with misadventure while on loan to one worse placed than Hanson himself. He later held a pastorate at Grantham, returning to Leeds, his wife's home town, in about 1870.

Throughout his life, John Hanson was in poor financial circumstances, and his last years, between his wife's death and his own in 1890, were spent with his sisters-in-law in Leeds, where he had a single room which he used both as a bedroom and as a work-room. A regular purchase of *Nature* was his only indulgence. With home-made apparatus he eked out a scanty living by the manufacture of microscope slides, in which art he obtained such fame that he was called on to supply a laboratory in Downing College, Cambridge, with slides to such a number that a printed list was required. He also acted as an agent for the supply of small scientific instruments (I have in my possession a small telescope which originally was from this source), and occasionally gave scientific lectures. He was a prolific writer of tracts on religious matters; but these could have been of little financial profit to himself (and were certainly not to his printers), but one of them is of special interest as it also advertises a list of his popular scientific lectures—the microscope, the telescope, life upon earth, Darwinism, insects, animal physiology, vegetable physiology, astronomy and geology.

H. GWYNEDD GREEN

LETTERS TO THE EDITORS

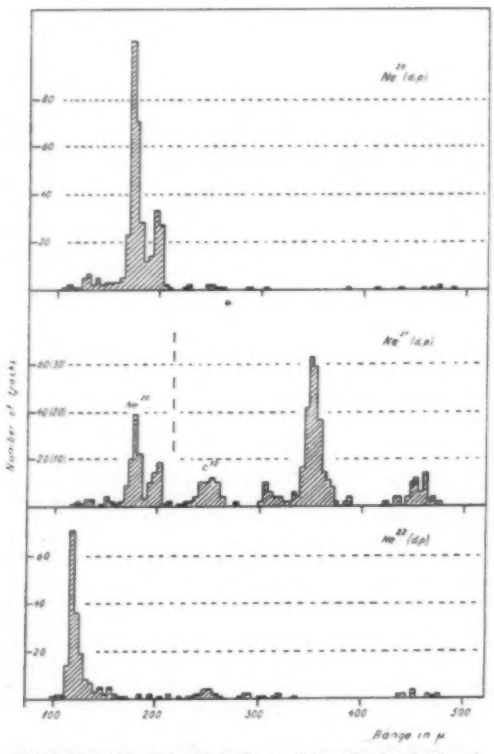
The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications

Deuteron Reactions with Separated Neon Isotopes

TARGETS with separated neon isotopes prepared by bombardment of silver plates with beams from a mass spectrograph have been used in this Institute for the study of the resonances in radiative proton capture[1]. Again using such targets, we have examined the (d,p)-reactions in neon and measured the energy of the protons by means of their range in a photographic emulsion.

The targets were bombarded *in vacuo* with deuterons of 1·5 MeV. from a van de Graaff generator. The particles emitted at 90° were allowed to impinge at an angle of 5° on a nuclear emulsion plate (Ilford *C*2, thickness 50 μ). The plate was separated from the vacuum system by a silver-coated mica foil, the thickness of which was just sufficient to cut off elastically scattered deuterons.

For the more abundant isotopes neon-20 (90·5 per cent) and neon-22 (9·2 per cent), the targets were saturated with neon[1], and a bombardment with 1–2 millicoulombs of deuterons gave a convenient number of tracks in the emulsion. The results are shown in the accompanying diagram and table. They



Distribution of track-length in the emulsion after bombardment of the different neon isotopes by 1·5-MeV. deuterons. In neon-21, tracks longer than 210 μ are measured over a greater area of the emulsion, and the number of tracks are given by the numbers in brackets

are in good agreement with results obtained by Elmer, Motz and Davison[2], who, using gas samples of neon which were enriched by thermal diffusion methods in neon-20 or neon-22, detected the protons by counting methods.

For the rare isotope neon-21 (0·28 per cent) the target will contain an appreciable amount of neon-20, owing to the presence of hydride ions in the beam. From measurements of the gamma-ray yield of the target under proton bombardment, it was estimated that the targets contained amounts of neon-21 and -20 in the ratio 1 to 2. Bombardment with 7·5-millicoulomb deuterons was therefore used, which gave a sufficient number of tracks in the emulsion.

The longest proton tracks found had, however, as expected, a range nearly equal to that of the protons from the reaction $N^{14}(d,p)N^{15}$. Due to impurities in the silver plates, such tracks had already been seen in the neon-20 and -22 exposures. The first results with neon-21 had therefore to be discarded, and we repeated the experiments using silver disks which were freshly turned and heated *in vacuo* to red heat. It was then possible to show that the number of the long tracks was seven times greater from the neon-21 target than from a silver plate which was treated in the same manner, except for the neon bombardment. We therefore conclude that the long group originates in the process $Ne^{21}(d,p)Ne^{22}$. The results are given in the diagram and table. They show two different groups of protons from the reaction just mentioned, and as expected we again find the two peaks due to $Ne^{20}(d,p)Ne^{21}$.

Process	Range in μ	E in MeV.*	Q_{exp}†	Q_{EMD}†
$Ne^{20}(d,p)Ne^{21}$	199	5·63	4·54	4·48 ± 0·10
	176	5·26	4·15	4·17 ± 0·09
$Ne^{21}(d,p)Ne^{22}$	460	9·29	8·34	
	350	7·96	6·95	
$Ne^{22}(d,p)Ne^{23}$	114	4·15	2·96	2·89 ± 0·11

* Energy (corrected for stopping in the mica foil).
† Deduced Q-values, and the values found by Elmer, Motz and Davison.

Under the assumption that the end group in the $Ne^{20}(d,p)Ne^{21}$ reaction belongs to the ground-state of neon-21, Elmer, Motz and Davison calculated for the mass of neon-21 the value 21·00074 ± 0·00019. They pointed out, too, that their results could be checked by studying the (d,p)-reaction in neon-21. Combining the mass equations for the processes in neon-20 and -21, we get the following expression:

$$Ne^{20} - Ne^{22} + 2(d - p) = Q_1 + Q_2,$$

where the energies Q_1 and Q_2 released in the two processes, respectively, correspond to the ground-states of the nucleus formed. Using the mass values compiled by Mattauch and Flammersfeld[3], the left-hand side is equal to $(13{\cdot}58 \pm 0{\cdot}16) \times 10^{-3}$ mass units. Now, our highest Q-values in the two reactions have the sum $(13{\cdot}83 \pm 0{\cdot}20) \times 10^{-3}$. We therefore conclude that in both processes the end groups found belong to the ground-states. Accordingly, we calculate for neon-21 the mass value 21·00062 ± 0·00015.

The other peak, at 350 μ, shows that neon-22 has an excited state at (1·39 ± 0·15) MeV. It may here be mentioned that May and Vaidyanathan[4], from the process $F^{19}(\alpha,p)Ne^{22}$, find the lowest excited level in neon-22 at (1·5 ± 0·2) MeV. (see note at end).

The Q-value found in the reaction $Ne^{22}(d,p)Ne^{23}$ (see table) shows that the mass of neon-23 is equal to or less than 23·00191 ± 0·00018. On the other hand, neon-23 is radioactive and disintegrates into

sodium-23 with emission of β-particles with maximum energy 4·3 ± 0·3 MeV. Using the value 22·99697 ± 0·00007 for the mass of sodium-23, we find, for the mass of neon-23, the value 23·00159 ± 0·00033. So far, these estimates are consistent with the assumption that the line found belongs to the ground-state of neon-23.

We wish to express our thanks to Prof. Niels Bohr for his interest in the work. Our thanks are also due to Miss C. Dilworth, who, during a visit to this Institute, gave us valuable advice on the photographic method, and Dr. J. Koch and K. O. Nielsen for having prepared the targets.

Note added in proof. In a recent paper, A. Zucker and W. W. Watson[5] have reported experiments in which by thermal diffusion the amount of neon-21 in the heavy fraction has been increased to nearly 1 per cent. The appearance of a long-range proton group is ascribed to an excited state of the neon-22 nucleus close to 1·37 MeV., a result which agrees well with our value (1·39 ± 0·15 MeV.).

J. Ambrosen
K. Marck Bisgaard*

Institute for Theoretical Physics,
University of Copenhagen.
Feb. 10.

* On leave from the Institute of Physics, University of Aarhus.

[1] Brostrom, K. J., Huus, T., and Koch, J., *Nature*, **160**, 498 (1947).
[2] Elmer, F. K., Motz, H. T., and Davison, P. W., *Phys. Rev.*, **71**, 917 (1947).
[3] Mattauch, J., and Flammersfeld, A., "Isotopic Report" (Tübingen, 1949).
[4] May, A. N., and Vaidyanathan, R. R., *Proc. Roy. Soc.*, A, **155**, 519 (1936).
[5] *Phys. Rev.*, **78**, 14 (1950).

Application of Proportional Scintillation γ-Ray Counters to the Determination of Radioactive Decay Schemes

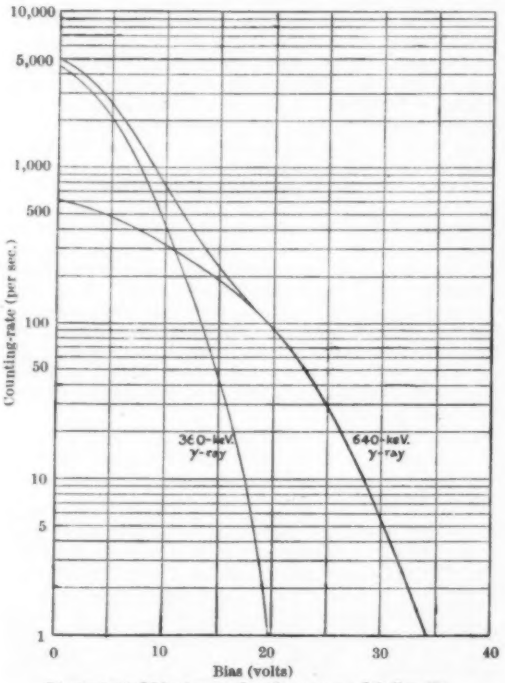
The determination of all but the simplest radioactive decay schemes necessitates a means of analysis of the γ-rays emitted, so that coincidences may be measured between the various γ-rays, and also between a particular γ-ray and the primary β-ray spectrum. Many nuclei emit γ-rays well spaced in energy, and a spectrometer of quite poor resolution would separate them sufficiently well for coincidence measurements. It has been known for some time that organic crystal scintillation counters act proportionally for α-particles[1]. The present work shows that such a counter may also be used as a crude γ-ray spectrometer, with an extremely high efficiency.

The crystal used, of naphthalene with a small percentage of anthracene, took the form of a disk 2 in. in diameter and ½ in. thick, and γ-rays from a well-collimated geometry passed through the greatest thickness. It was used with an *EMI* multiplier type *VX*.5032, feeding into a 2-Mc./s. amplifier. Preliminary measurements were made with γ-rays of cobalt-60, sodium-24 and iodine-131, of which only the latter are reported here. This is known to emit a main γ-ray at 363 keV. and a subsidiary one at 640 keV., with a branching ratio of about 15 per cent. Other lower-energy γ-rays are emitted which are not of interest here.

The pulses were analysed by means of a simple discriminator, and the proportion of the two γ-rays recorded at a given value of the bias was determined by absorption measurements in the well-collimated geometry used. The family of curves obtained showed clearly that at small values of the bias there are two components, and that, as the bias is increased, the component due to the lower-energy γ-ray is decreased relative to the one for the higher-energy γ-ray, until at 20 volts bias it becomes zero. By extrapolating the absorption curves for the harder component to zero absorber, the counting-rates for the two γ-rays at different values of the bias may be determined.

In the accompanying graph the composite bias curve, and also bias curves for the two γ-rays separately, are plotted. To get an idea of the efficiency of the crystal for counting these γ-rays, it was replaced by a copper-walled Geiger counter, which gave a counting-rate of 20 per sec. as against 5,000 per sec. for the crystal. The ratio of 250/1 fits in well with the calculated efficiency of the crystal for 360-keV. γ-rays at about 50 per cent. That for the 640-keV. γ-ray is 35 per cent; so even after the effect of the 360-keV. γ-ray has been completely eliminated, the higher-energy γ-ray is still counted with an efficiency of 5 per cent.

The counter has been applied to the determination of the maximum energy of the lower-energy β-group in coincidence with the 640-keV. γ-rays. The β-rays were counted with a Geiger counter operated just below the threshold, to eliminate the dead time, and working into a 2-Mc./s. amplifier. A conventional coincidence circuit with a resolution of 0·2 μsec. was used. An essentially weightless source was deposited on mica and sealed in with ¼-mgm. nylon sheet, and was of such a size that the genuine coincidence-rate at zero absorber thickness was about twice the accidental rate. A close geometry was used, with the source in contact with the crystal and a few millimetres from the β-counter. Coincidences were measured as a function of absorber placed before the



Discriminator bias curve for the γ-rays of Iodine-131

β-counter, at least 4,000 coincidences at each point being recorded. The genuine coincidence-rate decreased by a factor of about one hundred over the range of absorber values used. There was no trace in the coincidence-absorption curve of the main 600-keV. β-branch in coincidence with the 360-keV. γ-ray, though this, of course, contributes to the accidental coincidences. The absorption curve for the β-rays of cobalt-60 under the same conditions was also measured. The two energies were obviously very close, and analysis by Feather's method gives 315 keV. for the lower-energy β-group in iodine-131, a value in excellent agreement with that of Deutsch[2] based on very much less direct evidence.

PATRICK E. CAVANAGH
Atomic Energy Research Establishment,
Harwell, Berks.
Jan. 29.

[1] Harding, Flowers and Eppstein, *Nature*, **163**, 990 (1949).
[2] Metzger and Deutsch, *Phys. Rev.*, **74**, 1640 (1948).

Ultra-Violet Band-Systems of CF

THERE is little published information about the spectra of the diatomic carbon halides, and only for CCl has the vibrational analysis of a band-system been completed[1,2,6]. We have, therefore, recently examined some sources which seemed likely to yield a band-spectrum of CF. The most useful of these has proved to be an electrodeless discharge through a stream of fluorocarbon vapour, using a valve-oscillator dissipating about 300 watts at a wave-length of about 30 metres. At relatively high pressures, excitation of impurities such as CO and SiF does not occur, and an extraordinarily rich banded spectrum is obtained, which so far has been found to extend from about 1970 to 4800 A.

The spectrum can be divided into three systems: (i) a system of red-degraded bands forming five close sequences which lie in the region 1970–2210 A.; (ii) a second ultra-violet system of which the strongest feature is a double double-headed band degraded to the violet at 2240 A.; and (iii) an extensive system of bands not clearly degraded to either direction lying between 2300 and 4800 A.

Of these systems we have so far examined in detail only the two lying at shortest wave-length. The more extensive of these has the heads of its sequences at 1977, 2024, 2078, 2134 and 2192 A. The assignment of vibrational quantum numbers is not obvious from intensities alone, for the sensitivity of the plates and of the quartz prism spectrographs used varies rather sharply in this region. But from the vibrational analysis, it appears that the 2024 A. sequence is the 0,0 sequence. With this arrangement, about 34 bands have been assigned to a scheme represented by the following equation:

$$\nu_{\text{head}} = \left.\begin{matrix}49454\\49377\end{matrix}\right\} + 1191{\cdot}_0u' - 21{\cdot}_6u'^2 - 1304{\cdot}_7u'' + 10{\cdot}_6u''^2,$$

where $u = v + \frac{1}{2}$. Most of these bands are accompanied by somewhat weaker heads lying at a distance of between 20 and 60 cm.$^{-1}$ to higher wave-number; this distance varies with vibrational quantum number in the way expected for a head-origin separation.

The violet-degraded band at 2240 A. is strikingly similar in appearance to the γ-bands ($^2\Sigma - {}^2\Pi$) of NO. Its heads are at 44,679·0, 44,666·2, 44,604·1 and 44,585·2 cm.$^{-1}$. The separation of the inner heads, 74·$_9$ cm.$^{-1}$, is very close to the electronic interval (77 cm.$^{-1}$) found from the analysis of the other system above, and suggests that these systems may have a state in common. This view is supported by the observation of weaker violet-degraded heads at about 2304·0 and 2308·2 A., which are at about the right distances from the heads of the 2240 A. band (which is probably the 1,0 band) to be the 1,1 heads with a lower-state vibrational interval equal to that found for the lower state of the first system.

It seems likely that the lower state of these two systems is the ground-state of CF ($^2\Pi$). The multiplet separation, about 75 cm.$^{-1}$, is of the order expected from that observed[3,6] in CCl (96 cm.$^{-1}$) and is not far from the value 60 cm.$^{-1}$ predicted by Howell[3]. The force-constant, k_e'', $7{\cdot}37 \times 10^5$ dyne/cm., is also of the order expected by analogy with other halides, thus:

BeF	5·77	BF[4]	8·05	CF	7·37
BeCl	3·03	BCl	3·47	CCl	3·93

We are indebted to Messrs. I.C.I. (General Chemicals), Ltd., for the fluorocarbon used in these experiments.

Notes added on April 6. A rotational analysis of the 2240 band has now been made. This shows that it does indeed arise from a $^2\Sigma - {}^2\Pi$ transition, with $B'' \sim 1{\cdot}41$, $B' \sim 1{\cdot}69$ cm.$^{-1}$. The value of r_e'' for CF is thus about $1{\cdot}27_5$ A.

A vibrational analysis of system (iii) has recently been given by Venkateswarlu[5], who attributes it to non-linear CF_2.

E. B. ANDREWS
R. F. BARROW
Physical Chemistry Laboratory,
University of Oxford.
Jan. 15.

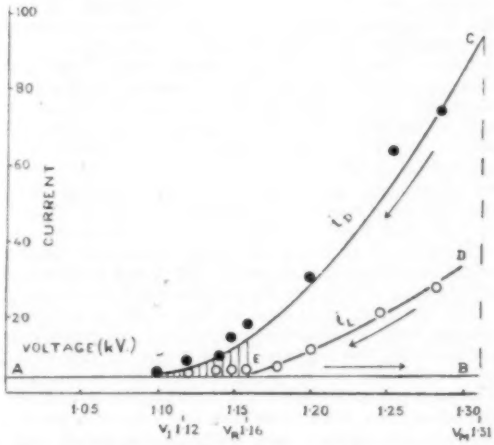
[1] Asundi and Karim, *Proc. Ind. Acad. Sci.*, **6A**, 328 (1937).
[2] Horie, *Proc. Phys. Math. Soc., Japan*, **21**, 143 (1939).
[3] Howell, *Proc. Phys. Soc.*, **57**, 37 (1945).
[4] Chrétien and Miescher, *Nature*, **163**, 996 (1949).
[5] *Phys. Rev.* (March 1950).
[6] Recent work by Venkateswarlu on CCl, *Phys. Rev.*, **77**, 79 (1950), leads to somewhat different values of the constants than those of Horie[2] which are used here, but the qualitative arguments are unaffected.

Production of an Irreversible Joshi Effect in the Hysteresis-Range below the Threshold Potential

THE fundamental importance of the threshold potential V_m in the production of the Joshi effect Δi and the preferential incidence of the latter in the high-frequency components of the discharge current have been established[1–6]. Results were suggestive when Δi was studied in chlorine at and below V_m. Until this latter is reached, the current is small, say, i_1; it increases suddenly by a large amount at V_m, and rises rapidly thereafter. On decreasing the voltage below V_m, it decreased gradually to i_1 at V_1 (see graph). *CA* denotes i_D, the current in the dark when the voltage is reduced below V_m, and *DE* the corresponding current i_L under irradiation. The larger current (in the dark) while decreasing below the voltage V_m is due to hysteresis.

The Joshi effect below V_m increased progressively to almost 100 per cent current diminution in light at a certain voltage, say, V_R, and continued to be so up to V_1. Within this range of voltage V_R—V_1, it was remarkable to observe that the photo-suppression of i and also of the associated high frequencies, con-

stituting a (negative) Joshi effect, was irreversible. The photo-current, that is, the current in light i_L, continued to be negligibly small, free from high frequencies and equal to i_1, the original pre-V_m current, *even on shutting off the light*. The production of *irreversible* Δi does not seem to have been observed so far and has obvious significance for the mechanism of Δi. Its delimitation was therefore investigated in some detail. It may be emphasized that initially, as the voltage is reduced below V_m, the effect Δi is reversible, light $\rightleftharpoons$ dark, so long as the voltage is such that the photo-current exceeds i_1. Apparently, a critical condition is reached where i_L reaches i_1, when Δi becomes irreversible. It must be mentioned that after the current was suppressed irreversibly at V_1, in order now to get the lower part of the hysteresis loop on the left of V_R, the potential had to be increased to V_m, when the current rose along ABC; and had to be decreased along CA. The voltage-range over which the irreversible Δi occurs is limited; it is, however, well defined and reproducible *ad libitum*. This suppression in light of the conductivity and the constituent high frequencies persists even if the system is kept under excitation in the dark at the above voltage for quite an appreciable period. The larger current and restoration of the characteristic high frequencies set in only on increasing the applied potential.



Reversible negative Joshi effect in chlorine (at 90 mm. of mercury and 27° C.) at 50 c./s.

With increase in light intensity, the irreversible effect sets in at a higher voltage V_R; the range V_R—V_1 is thus increased. The frequency influence is essentially similar and in the order, unfiltered white > blue > green > red. Interesting results were obtained on heating the system to 90° C.; first, the current in the dark below V_m was reduced to i_1 at a voltage less than V_m; secondly, the region of irreversibility mentioned above was practically abolished; and thirdly, irradiation caused a large *positive Joshi effect*, that is, a photo-enhancement of conductivity.

During subsequent work in these laboratories, it has been found that, restricted within a narrow potential range, the above irreversible effect now observed in chlorine occurs in other gases and vapours also, when they are energized at or below the threshold potential V_m, *provided the hysteresis loop ABC is (at least) once traversed*. This illustrates the significance of Joshi's general result that 'ageing' in the discharge is necessary for the inception of Δi, as also is its maximum, characteristic of the given exciting conditions[7,8]. It must be emphasized that both hysteresis and Δi are at their maxima near V_m [7].

The generality of these findings is in accord with Joshi's theory[1], according to which photo-electric emission characterized by a *low* work function, at an electrode layer consisting of electrons, ions and excited particles, derived from the discharge space, is a primary seat of Δi.

B. R. Marathe
S. S. Bommannavar

College of Science,
Benares Hindu University.
Dec. 17.

[1] Joshi, *Curr. Sci.*, **8**, 548 (1939); **14**, 175 (1945); **15**, 281 (1946); **16**, 19 (1947).
[2] Joshi, *Benares Hindu Univ. J.*, **8**, 99 (1943).
[3] Joshi, *Nature*, **154**, 147 (1944).
[4] Joshi, *Curr. Sci.*, **14**, 35 (1945).
[5] Joshi, *Curr. Sci.*, **14**, 67 (1945).
[6] Joshi, *Proc. Ind. Acad. Sci.*, **22**, 225 (1945); **22**, 389 (1945). Joshi and Lad, *ibid.*, **22**, 293 (1945).
[7] Joshi (unpublished results).
[8] Joshi and Deshmukh, *Nature*, **147**, 806 (1941).
[9] Dee, *Phil. Mag.*, **39**, 978 (1948).
[10] Deshmukh and Sirsikar, *J. Amer. Chem. Soc.*, **70**, 3924 (1948).
[11] Deshmukh and Sirsikar, *Proc. Nat. Inst. Sci. (India)*, **14**, 157 (1948).

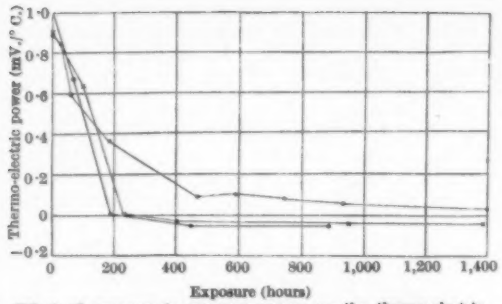
Effect of Mercury on the Thermo-Electric Properties of Selenium

Experiments have recently been made on the thermo-electric properties of selenium specimens of high purity (kindly supplied by Mr. T. R. Scott, of Standard Telecommunication Laboratories, Ltd.), with known amounts of residual contamination and sometimes with deliberate additives. Amorphous selenium was moulded into disks of 3 mm. thickness and 10 mm. diameter, and afterwards converted into the crystalline form by heat treatment. Gold electrodes were applied to the flat surfaces by vacuum evaporation. Various temperature differences were established between these surfaces, and the corresponding thermo-powers were determined, using nickel as a standard of reference.

It was found that the thermo-electric power (dE/dT) of these specimens is very nearly independent of temperature in the range of 30°–60° C. In this respect selenium differs from titanium dioxide (TiO_2) [1] and most other semi-conductors, except bismuth sulphide and stannous sulphide. These materials are, however, characterized by very low activation energies[2], whereas the activation energies recorded for selenium are about 0·1 eV. The polarity of the observed thermo-power is as expected for a deficit semi-conductor.

A number of specimens were exposed to mercury vapour at room temperature in the presence of air at atmospheric pressure. This resulted in a pronounced decrease of thermo-power, as shown on the graph. The effect was far more rapid when experiments were carried out in a rough vacuum.

Reference to the position of nickel and mercury in the thermo-electric series shows that the reversal of polarity cannot be due simply to the formation of liquid mercury filaments within the crystalline medium. (A corresponding reversal of *photo-voltaic* effects has been observed by Brown[3].) By removing



Effect of exposure to mercury vapour on the thermo-electric power of selenium–nickel couples

thin layers of the cylindrical surface it was found that though the effect of mercury is greatest at the surface, quite deep penetration into the selenium specimen takes place. The exact mechanism whereby mercury—which is expected to act as an electron donor—gives rise to the above phenomenon is still under investigation. In the meantime, it is of interest to note that similar effects are not observed when metallic mercury is added to the selenium melt before moulding. Up to 1·6 per cent by weight of mercury was added in this way without giving rise to any significant change of thermo-power. It must be concluded that the mercury added by the two methods is present in two entirely different forms. It is conceivable that mercury absorbed from the vapour phase is confined to the grain boundaries, whereas its addition to the melt may result in a more homogeneous distribution, perhaps in chemical combination with the selenium.

We would like to thank Prof. R. W. Ditchburn for placing research facilities at our disposal and for much helpful advice.

H. K. Henisch
M. François

Department of Physics,
University of Reading.
Jan. 29.

[1] Henisch, *Elect. Comm.*, **25**, 163 (1948).
[2] Hochberg and Sominski, *Phys. Z. d. Sowjetunion*, **13**, 198 (1938).
[3] Brown, *Phys. Rev.*, **2**, 153 (1913).

Detection and Estimation of Small Amounts of Impurities in the Air

In the course of measuring, in air, the surface potential change produced by the deposition of a monomolecular layer of fatty acid on a polished stainless-steel plate, transient changes of potential were observed, due to the passage over the plate of vapour impurities in the laboratory air. Some quantitative measurements of this effect have been made, particularly at low concentrations, thus extending the earlier work of Frost[1,2].

The surface potential was measured using a modification of the method described by Zisman[3]. A metal reed was made to vibrate above the plate carrying the monomolecular layer, and the A.C. voltage so developed was fed through a selective amplifier and phase-sensitive detector to a D.C. recorder. The voltage on the reed was adjusted to give a null reading when a stream of clean dry air was passed over the plate. The change of potential which occurred

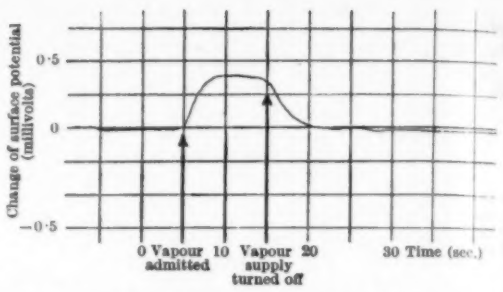


Fig. 1. Recorder trace showing change of surface potential when ethyl chloroacetate (5 parts in 10^8 by weight) was mixed with air stream

when certain vapours were introduced at a known rate into the air stream was measured. Fig. 1 shows the type of response obtained when, for example, ethyl chloro-acetate vapour was introduced into the air stream.

The greatest changes of surface potential have been observed when polar compounds such as ethyl alcohol, ether, ethyl chloro-acetate, hydrogen chloride or nitrobenzene are used. Changes of surface potential giving a signal/noise ratio of 5/1 have been obtained for concentrations of one part in 10^7 by weight of vapour in air (or nitrogen). A total quantity of 10^{-8} gm. of vapour introduced into the air stream produced a measurable transient change of potential of the surface of the plate. Much smaller, but still definite, changes of potential have been observed using apparently non-polar molecules such as benzene, octane or carbon tetrachloride. The change of potential observed can be either of negative or positive sign, depending on the vapour introduced. Under clean air conditions, the drift of surface potential with time for the plates used was small; drifts of 0·1 mV. in 2 hr. and 7 mV. in one week were observed.

The manner in which the surface potential changes with concentration is shown in Fig. 2 and resembles a simple type of van der Waals adsorption isotherm.

The amount and sign of the surface potential change may be selectively modified by previously conditioning the surface of the plate by depositing on it molecular layers, using the Blodgett technique[4]. The adsorption by such conditioned surfaces, and also the adsorption when more than one vapour is present in the air stream, are being investigated with improved equipment of greater sensitivity.

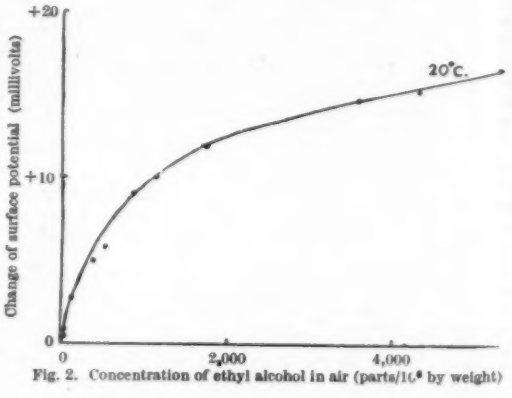


Fig. 2. Concentration of ethyl alcohol in air (parts/10^8 by weight)

Acknowledgment is made to the Chief Scientist, Ministry of Supply, for permission to publish this letter.

G. PHILLIPS
Signals Research and Development Establishment,
(Ministry of Supply),
Christchurch,
Hants.
Jan. 27.

[1] Frost, A. A., and Hurka, V. R., *J. Amer. Chem. Soc.*, **62**, 3335 (1940).
[2] Frost, A. A., *Trans. Electro-Chem. Soc.*, **82**, 259 (1942).
[3] Zisman, W. A., *J. Chem. Phys.*, **1**, 656 (1933).
[4] Blodgett, K., *J. Amer. Chem. Soc.*, **57**, 1007 (1935).

Mapping Chromosome Centromeres by the Analysis of Unordered Tetrads

IN many fungi, such as most of the Ascomycetes and Ustilaginales, the products of meiosis are arranged regularly in a linear order, and by examining them or by isolating them in order, it is possible to distinguish between segregation of a pair of allelomorphs at the first and at the second division of meiosis. The relative frequencies of first- and second-division segregation for a given locus are dependent on the frequency of crossing-over between that locus and the centromere of the chromosome. Hence, the centromere can be plotted on the cross-over map of the chromosome.

In an unordered tetrad, in which the products of meiosis are not linearly arranged, direct observation of the relative frequencies of first- and second-division segregation for particular loci is not possible. When segregation occurs for two pairs of allelomorphs (A/a and B/b), a proportion of meioses will result in all four products differing from one another (1 AB, 1 ab, 1 Ab and 1 aB), the remainder having two types of products (either 2 AB and 2 ab, or 2 Ab and 2 aB). If the loci are linked, the proportion of four-type tetrads is dependent on the frequency of crossing-over in the segment of chromosome lying between them. On the other hand, if the loci are not linked, the relative frequencies of two- and four-type tetrads are dependent on the frequencies of crossing-over between the loci and the centromeres of their respective chromosomes. The relationship in the latter case has been shown[1,2] to be:

$$p = x + y - \frac{3xy}{2},$$

where p is the proportion of four-type tetrads and x and y are the proportions of second-division segregation at the A and B loci, respectively. From this expression it is not possible to determine the precise frequencies of first- and second-division segregation for either locus. However, by introducing a third independent locus, the required proportions of first- and second-division segregation can be determined for all three loci. Lindegren[3] indirectly made use of this fact in mapping the centromeres of chromosomes in yeast, employing a graph of the proportion of two-type tetrads for various frequencies of second-division segregation at two loci. However, this method is awkward, as it would require a three-dimensional graph for a straightforward solution. Perkins[3] has pointed out that an algebraic solution is possible, but has not obtained the actual expressions for the proportions of first- and second-division segregation for the three loci, such as would be needed in applying the method to experimental data. The algebraic solution is as follows.

With a third pair of allelomorphs (C/c), such that the locus of C shows no linkage to either the A or B loci,

$$q = y + z - \frac{3yz}{2} \quad \text{and} \quad r = x + z - \frac{3xz}{2},$$

where q and r are the proportions of four-type tetrads for loci B and C and for loci A and C, respectively, and z is the proportion of second-division segregation at the C locus. The solution of the three simultaneous equations gives:

$$x = \frac{2}{3}\left[1 \pm \sqrt{\frac{4 - 6p - 6r + 9pr}{4 - 6q}}\right]$$

$$y = \frac{2}{3}\left[1 \pm \sqrt{\frac{4 - 6p - 6q + 9pq}{4 - 6r}}\right]$$

$$z = \frac{2}{3}\left[1 \pm \sqrt{\frac{4 - 6q - 6r + 9qr}{4 - 6p}}\right].$$

When there are two real solutions to any of these formulæ, one is necessarily greater than 2/3 and the other less than 2/3. Since proportions of second-division segregation greater than 2/3 are likely to be rare[4], the smaller value is more likely to be the true one.

These expressions could be usefully applied in many analyses of unordered tetrads. Thus, Quintanilha and Balle[5] analysed more than two hundred tetrads of spores from the tetrapolar Hymenomycete *Coprinus fimetarius* (L.) Fr. showing segregation, not only for the two loci for heterothallism, but also for a gene causing dwarfness ('nanism'). They found no linkage between the loci, and so their unpublished tetrad data should enable the three loci to be mapped in relation to the centromeres of their respective chromosomes. Lindegren[3] has published extensive results from tetrad analysis in yeast. The formulæ above provide a simpler and more accurate means of mapping centromeres than does his graphical method. The following example from his data shows the use of the formulæ. Three unlinked loci a (mating-type), ad (adenine-less) and g (galactose-nonfermenter) gave the following fractions of four-type tetrads: a ad 91/169, a g 167/327 and ad g 45/147. From the above formulæ, the proportions of second-division segregation for the three loci are a 0·474 (or 0·859), ad 0·222 and g 0·128, and hence the distances in cross-over units of the three loci from their respective centromeres are a 23·7 (or 42·9), ad 11·1 and g 6·4. Lindegren's corresponding figures, obtained graphically, are a 23·6, ad 11·25 and g 6·25.

H. L. K. WHITEHOUSE
Botany School,
Cambridge.
Jan. 19.

[1] Whitehouse, H. L. K., *New Phytol.*, **48**, 212 (1949).
[2] Perkins, D. D., *Genetics*, **34**, 607 (1949).
[3] Lindegren, C. C., *Hereditas*, Supp. Vol., 338 (1949).
[4] Mather, K., *Biol. Rev.*, **13**, 252 (1938).
[5] Quintanilha, A., and Balle, S., *C.R. Soc. Biol.*, **129**, 191 (1938).

South African Fossil Hominoids

PROF. S. ZUCKERMAN'S remarks concerning the teeth of the fossil Australopithecinæ of South Africa[1] call for certain comments.

In the first place, it is open to serious question whether the major dimensions and indices of individual teeth can by themselves provide adequate

information on which to base statements regarding affinities of primitive hominids and anthropoid apes. Secondly, the comparison between the Australopithecine dentition and that of *Homo sapiens* of to-day may be misleading to some readers; comparisons should be made rather with the primitive hominids of the *Pithecanthropus* group from Java and China. Lastly, the great quantity of Australopithecine material available has now made it possible to take a comprehensive view of the total morphological pattern presented by the dentition, without the need to rely for the assessment of affinities on the dimensions of individual teeth treated as isolated abstractions.

According to my own comparative studies[2], based on more than four hundred ape skulls, the Australopithecine dentition displays certain hominid features which severally find no precise parallel in any of the known apes (recent or extinct), and others which may very occasionally be found singly if diligently sought in a large series. But conclusions regarding the hominid nature of the dentition must ultimately be based on the total pattern determined by all these features in a particular combination. Among the features referred to are the small size (relative and absolute) and the spatulate form of the canine combined with its flat wear (by attrition with the opposing canine) and its relative position in the tooth row, the small incisors, the non-sectorial bicuspid form of $Pm\overline{3}$ (with cusps of approximately equal bulk and height and well-developed anterior and posterior foveæ), the evenly curved parabolic contour of the dental arcade with a *consistent* absence of any diastema, the flat type of wear of the premolars and molars in the earlier stages of attrition, and, in the temporary dentition, the shape and dimensions (relative and absolute) of the milk canine combined with the details of the cusp pattern of $dm\overline{1}$.

Many specimens of jaws and palates of the Australopithecinæ, as well as numerous isolated teeth, have now been discovered and described, and at least three excellent specimens of the temporary dentition. All these bear witness to the fact that the same hominid pattern is quite consistently present in the Australopithecine dentition. So far as I am aware, no similar combination of *all* these hominid features together has been found in the dentition of any of the anthropoid apes. If even one such specimen is known (let alone a whole series of individual specimens found at random in a common group), could we be informed where it is to be seen? Unless such specimens can be produced, it does not seem possible seriously to controvert the conclusions expressed by a number of competent palæontologists that, in their dentition, the fossil Australopithecinæ show a closer structural resemblance to primitive hominids than do any of the known anthropoid apes. The implications of these conclusions have quite recently been corroborated in a remarkable way by studies of other parts of the skeleton, particularly the almost complete os innominatum which was actually found *in situ* at Sterkfontein[3].

W. E. Le Gros Clark

Department of Human Anatomy,
University Museum,
Oxford.
April 24.

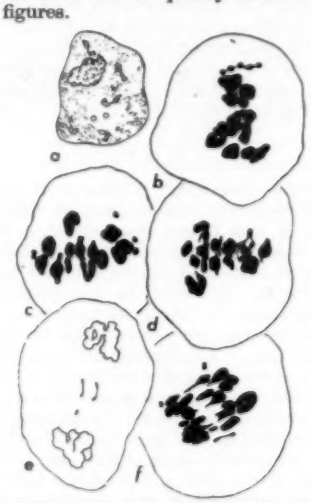
[1] *Nature*, **165**, 652 (1950).
[2] *Quart. J. Geol. Soc.*, **104**, 225 (1950).
[3] Broom, R., and Robinson, J. T., "Further Evidence of the Structure of the Sterkfontein Ape-Man Plesianthropus". Part 1. Transvaal Museum Mem. No. 4 (1950).

Accessory Isochromosomes in the Moss *Dicranum majus*

In a recent paper[1], I have described four heterochromatic accessory chromosomes of a very small type in the moss *Grimmia Mühlenbeckii* Schimp. Further investigations on meiosis in mosses have revealed five accessory chromosomes of the same type in a population of *Dicranum majus* Turn. found near the State Horticultural Institute in south-west Finland. In their behaviour the accessories resemble in many respects those found in *Grimmia*. Besides being small, they are heterochromatic and incapable of conjugating with the normal chromosomes though, however, conjugating freely with one another.

The symmetrically two-armed shape of the accessories can be clearly seen in the resting nuclei of the young archesporial cells of the sporogonium (Fig. *a*). This heteropycnotic character can also be observed, although less clearly, during the meiotic prophase stages.

The gametophytic chromosome number of the species, and thus also the number of bivalents in the first meiotic metaphase, is, as is common in the genus *Dicranum*[2], twelve. One of the bivalents is large, slightly asymmetrical, heteropycnotic and usually precocious in its anaphase movement (Figs. *a*, *b*, *c*). Most probably it is the site of the sex-determining genes of this dioecious species. Although the accessories are capable of conjugating with one another, they occur, however, occasionally, either totally or only in part, as univalents. A peculiar characteristic of the conjugation of the accessory chromosomes is their ability frequently to form multivalent associations. Besides conjugation in pairs (Figs. *c*, *e*, *f*), which is the only mode of conjugation in *Grimmia*, there exist multivalent associations formed by three, four or five accessories (Figs. *b*, *d*). The usual type of these associations is the chain (Fig. *b*); but rings can also be found occasionally (Fig. *d*). The following results from forty spore mother cells show the frequency of the various conjugation figures.



(*a*) Nucleus from a young archesporial cell. Five heteropycnotic accessories and the large association of sex chromosomes. (*b–d*) *I–M* from a spore mother cell. (*b*) Chain of the five accessories. (*c*) Two conjugated and three univalent accessories. (*d*) Ring of the five accessories. (*e*) *I–T* from a spore mother cell. All the accessories eliminated. (*f*) *I–A* from a spore mother cell. Two conjugated accessories and three univalents. All the preparations are aceto-orcein squashes. × 1,600

Number of conjugated accessories	Number of univalent accessories	Number of cells
2	3	13
3	2	6
4	1	6
0	5	5
5	0	4
2 + 2	1	3
3 + 2	0	3

Some of the univalent accessories are usually situated outside the first metaphase plate. Those that have conjugated lie regularly in the equator (Figs. *b*, *c*, *d*, *f*). The anaphase segregation of the accessories takes place irregularly. Individual univalents may be eliminated. The conjugated accessories may also suffer the same fate owing to the delayed division (Fig. *e*). The univalent accessories do not divide in the first division (cf. ref. 3).

In the second-division metaphase, congression of the accessory chromosomes is still more irregular than in the first division. Apparently they all divide in the second division, being, however, rather frequently eliminated.

These observations have so far concerned only one population, most probably comprising a single clone that has arisen by vegetative propagation, and they do not indicate the general distribution and possible numerical variation of the accessories in the species.

The ability of the accessories to form multivalent associations even of ring shape incorporating the whole complement of the five accessories warrants the assumption that all the accessories are isochromosomes identical with one another. The occurrence of isochromosomes among accessories has repeatedly been reported earlier in the Phanerogams[2,4]. The conclusion can be drawn that the accessories in *Dicranum* have arisen at some time by misdivision of the centromere[5]. Owing to its positive selection value the new chromosome has become established in the normal chromosome complement. The number of isochromosomes may be increased during evolution by repeated misdivisions. Since the accessories are identical and probably almost inert, their increasing number is restricted only when their cumulative effect[6] exceeds the limit of benefit to the general physiology of the plant.

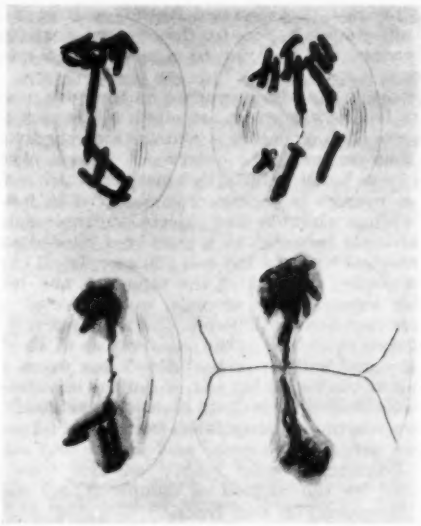
ANTERO VAARAMA

State Horticultural Institute,
Piikkiö, Finland.
Jan. 12.

[1] Vaarama, A., *Portug. Acta Biol.*, (A), Goldschmidt Vol., 47 (1949).
[2] Vaarama, A., [*Bot. Not.*, 133 (1950)].
[3] Östergren, G., *Hereditas*, **33**, 263 (1947).
[4] Müntzing, A., *Hereditas*, **30**, 213 (1944).
[5] Darlington, C. D., *J. Genet.*, **39**, 351 (1940).
[6] Müntzing, A., *Hereditas*, **29**, 91 (1943).

Effect of Sodium Ribose Nucleate on Meiosis of Grasshoppers

KODANI[1] discovered that in onion root tips treated with solutions of sodium ribose nucleate of certain concentrations for certain lengths of time, morphological changes in the chromosomes and abnormalities in mitotic division were induced. We have studied the chromosomal abnormalities occurring in meiosis of some grasshoppers, into which 5 per cent sodium ribose nucleate solution was injected, after the *p*H of the solution was raised to 7 by addition of sodium hydroxide solution.



The material was killed twenty-four hours after treatment, and the testes were fixed with Allen–Bouin's solution. The sections were stained with Heidenhain's Iron-hæmatoxylin or examined by means of the Feulgen reaction. The meiosis proceeds normally up to metaphase; but abnormality appears in anaphase and telophase (see illustration). The abnormality is highly characteristic; some of the chromosomes stick together, and irregular anaphase results. Some daughter chromosomes do not separate normally and produce a kind of chromatin bridge between the daughter nuclei. This irregularity is apparently due to the change in the colloidal state of the chromosomes, so that it is likely that by this treatment the chromosomes as a whole are affected. According to Bauch[2], the mitotic poisons are classified into two main groups: (1) poisons which do not inhibit nuclear division, but only cell division; (2) karyoclastic or mitotic poisons, which either suppress the formation of the spindle ('spindle poisons'), or cause the chromosomes to stick together ('chromosome poisons').

This investigation reveals that, so far as the morphological features of the chromosomal abnormalities are concerned, sodium ribose nucleate seems to belong to the category of 'chromosome poisons' like trypaflavin, X-rays, high and low temperatures, etc.

Y. OJIMA
M. OGAKI

Zoological Institute,
University of Kyoto,
Kyoto. Jan. 9.

[1] Kodani, M., *J. Hered.*, **39**, 327 (1948).
[2] Bauch, R., *Naturwiss.*, **34**, 346 (1948).

Action of Cyanate on the Bone Marrow of Rats

DUSTIN[1], acting on a suggestion made by Schütz, investigated the action of sodium cyanate on cells in mitosis. He reported that six hours after a dose of 5 mgm. had been given to mice, it was possible to see pycnotic degeneration in cells of the intestinal mucosa, splenic lymphoid tissue and cortical tissue

of the thymus. Loveless and Revell[3] considered that these effects were due to the general toxicity of the cyanate ion and not to a specific anti-mitotic action.

The action of sodium cyanate on the bone marrow of rats has now been investigated. This particular tissue was chosen because it contains actively dividing cells that can easily be observed. Sodium cyanate made for us by Dr. Schütz, by a method[3] which ensures that no cyanide is present, was dissolved in 0·9 per cent sodium chloride and injected intramuscularly. The animals belonged to a pure-bred hooded strain and weighed between 180 and 250 gm. In all experiments control animals of the same sex and weight as the experimental animals were injected with 0·9 per cent sodium chloride, and their marrow and blood were examined in the same way as those of the rats injected with cyanate. Blood was taken from the tail at the beginning and end of the experiments. The rats were killed by a blow on the head, and marrow was immediately taken from the tibial cavity. Smears were fixed in osmic acid vapour and stained with Leishman–Giemsa stain; sections were also prepared by the method of Campbell[4] and stained with Hæmatoxylin and Eosin.

The results can be briefly summarized as follows:

(*a*) Large single doses (10–30 mgm./100 gm. body-weight) reduced the number of mitoses in the marrow from the normal level of 11 per 1,500 nucleated cells to about 3. Mitosis was never completely suppressed. The reduction was greatest two hours after the injection, and after twenty-four hours the number of mitoses was again normal or even slightly raised. A few pycnotic nuclei were seen in both smears and sections.

No consistent alterations were found in the peripheral blood after two hours, but at four hours there was usually a rise in polymorphonuclear leucocytes in the experimental and also in the control animals.

(*b*) Repeated daily doses (10 mgm./100 gm. body-weight) produced the effects (lethargy, loss of weight, loss of appetite) described by Schütz[5]. The bone marrow showed alterations that reached their maximum after about ten to twelve injections. Typical results which were obtained from two experimental and two control animals after nine injections are shown in the accompanying table.

Effect of Injections of Sodium Cyanate on the Bone Marrow of Rats

	Animals given sodium cyanate	Animals given sodium chloride
Polymorphs (per cent)	32·9	36·8
Myelocytes "	12·8	16·3
Erythroblasts "	37·6	19·7
Lymphocytes "	10·9	20·8
Mitoses in 1,500 cells	23	9

It will be seen that the results were different in several important respects from those observed after the single doses. The most remarkable finding was that the number of mitoses was not decreased but was very considerably increased. No one phase of mitotic activity predominated. In addition, the percentage of erythroblasts was doubled and that of lymphocytes halved.

In the peripheral blood there were rises of one-fifth in the hæmoglobin concentration and the red-cell count. The total leucocyte count was never more than slightly raised; but the differential count showed considerable alterations. The number of polymorphs was sometimes eight to ten times greater than in the normal animals. The lymphocytes were reduced to about one-tenth of the previous figure.

After about twenty injections, the rats receiving sodium cyanate showed all the signs of cyanate poisoning; their clinical condition deteriorated considerably, and the number of mitoses in the marrow showed a tendency to fall. The bone marrow and blood returned to normal eight to ten days after the injections were stopped, even in animals which had been severely poisoned.

Daily injections of these doses of sodium cyanate appear, therefore, to have the following effects on mitotic activity in the bone marrow. There is at first a slight depression: this is followed by a considerable stimulation, and finally by another depression which is probably toxic in origin. These results do not support convincingly Dustin's suggestion that cyanate is a specific antimitotic agent. They are in accordance with the findings of Skipper, Bryan, Riser, Welty and Stelzenmuller[6], who were unable to detect any leucopenia after injecting normal mice with large single doses of potassium cyanate. The action of sodium cyanate is being further investigated, and a full account of the experiments will be published as soon as possible. It may be that the effects on the bone marrow and blood are secondary to changes produced elsewhere in the body. It is known, for example, that cyanate may be involved in respiratory processes and that it causes alterations in kidney function. These and many other possibilities will need exploration.

R. F. A. Dean
F. W. Gunz

Medical Research Council,
Department of Experimental Medicine
and
Department of Radiotherapeutics,
University, Cambridge.
Jan. 30.

[1] Dustin, P., *Nature*, **159**, 794 (1947).
[2] Loveless, A., and Revell, S., *Nature*, **164**, 938 (1949).
[3] Bader, R., Dupré, D. J., and Schütz, F., *Biochim. Biophys. Acta*, **2**, 543 (1948).
[4] Campbell, A. C. P., *J. Path. Bact.*, **60**, 633 (1948).
[5] Schütz, F., *Experientia*, **5**, 133 (1949).
[6] Skipper, H. E., Bryan, C. E., Riser, W. H., jun., Welty, M., and Stelzenmuller, A., *J. Nat. Cancer Inst.*, **9**, 77 (1948).

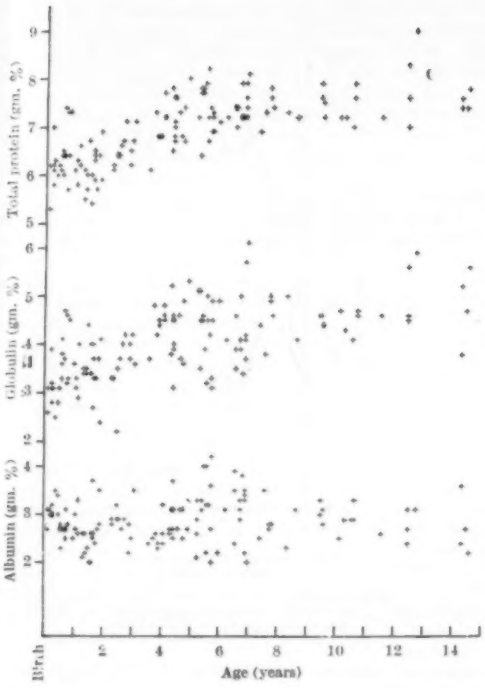
Physiological Variations in Serum Proteins in Cattle

It is well known that protein values for the human infant are lower than those found in the adult, the difference being due to lower values for both albumin and globulin fractions. Adult levels are reached by the age of eighteen months.

The accompanying diagram shows the distribution, with age, of the total protein, albumin and globulin of serum, estimated by the tyrosine method of Greenberg[1], of 126 heifer calves, heifers and cows of ages ranging from six weeks to 14 years 7 months. All were of the white Fulani type and all had received a full protein supplement (groundnut cake, palm kernel cake and guinea-corn) from a few days after birth.

Cattle would appear to differ from man in that the increase in total protein with age appears to be associated with an increase in the globulin fraction only; further, the adult value is not reached until the comparatively late age of at least five years.

Examination of the curve indicates that it is sigmoid in type; the relatively high values in the



young calf can be accounted for by a temporary rise in globulins following ingestion of colostrum.

Edwards[3] implies that there may be a sex difference in serum proteins in cattle. Also using the tyrosine method, he found "the total protein content to vary between 7·5 and 9·5 g.%, the higher values being obtained in bullocks". Total and differential protein values for male and female stock more than five years old are shown in the accompanying table.

Cattle from the Livestock Improvement Centre, Vom, had received protein supplements, those slaughtered at Bukuru had been purchased from various Fulani herds and had presumably received no supplementary feeding-stuffs of any kind. In neither group is the difference between the values obtained for male and female stock significant.

The variation in the albumin/globulin ratio with age may have some practical significance if it is desired to make use in cattle of tests, such as many of the flocculation tests used for detection of hepatic damage, which depend for their function upon changes in this ratio. The findings also indicate that, in any experimental work involving the estimation of serum proteins in cattle less than five years old, both experimental and control animals should be of approximately the same age.

I wish to thank Mr. W. E. Hill, officer-in-charge, Livestock Improvement Centre, Vom, for his co-operation, and Mr. W. G. Beaton, director of Veterinary Services, Nigeria, for permission to publish this work.

R. J. Garner

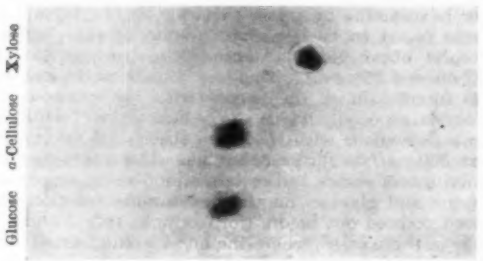
Research Laboratory,
Veterinary Department,
Vom, Bukuru P.O.,
N. Nigeria.
Jan. 5.

	Total protein (gm. per cent)	Albumin (gm. per cent)	Globulin (gm. per cent)
Cattle from Livestock Improvement Centre, Vom			
Cows (54)	6·4–9·0 Mean 7·44±1·32	2·0–4·2 Mean 2·97±0·28	3·1–6·1 Mean 4·48±0·64
Bulls (10)	7·2–8·4 Mean 7·88±0·40	2·3–3·6 Mean 3·10±0·48	3·8–5·6 Mean 4·78±0·69
Cattle slaughtered at Bukuru slaughter slab			
Cows (18)	5·5–8·8 Mean 7·73±0·80	1·7–3·5 Mean 2·41±0·33	3·8–6·8 Mean 5·32±0·86
Bulls (84)	5·6–9·6 Mean 7·55±0·76	1·3–3·7 Mean 2·46±0·41	3·8–7·6 Mean 5·09±0·86

[1] Greenberg, D. M., *J. Biol. Chem.*, **82**, 545 (1929).
[2] Edwards, F. R., *Brit. Med. J.*, i, 73 (1944).

Association of Xylan with α-Cellulose in Jute

On account of the fact that some of the xylan in straws and hardwoods remained in the α-cellulose, Hawley and Norman[1] considered it to be intimately associated with the α-cellulose. According to Astbury, Preston and Norman[2], this association corresponds to the relationship between the components of a solid solution or a mixed crystal. Norman[3] regards xylan as an integral part of the cellulosic aggregate, oriented in the same way as true cellulose and taking part in the micelle. This view received support from the fact that xylan-free α-cellulose could not be obtained from many sources[4]; some celluloses failed to part with their xylan even on boiling with 10 per cent sodium hydroxide[5]. Chemical combination between xylan and α-cellulose has therefore been suggested.



Filter-paper chromatogram of sugars obtained by hydrolysing α-cellulose from jute

In a previous communication[6] from these Laboratories, it was shown that α-cellulose prepared from chlorite holocellulose of jute gave practically the same amount of 'furfural' (0·9 per cent) as did purified cotton cellulose; xylan could not, therefore, be present in α-cellulose from jute in appreciable amount, if at all.

α-Cellulose has now been hydrolysed by dissolving in 72 per cent sulphuric acid and then boiling under reflux after dilution with water to 3 per cent. The acid was removed with barium carbonate and the filtrate concentrated under reduced pressure to a

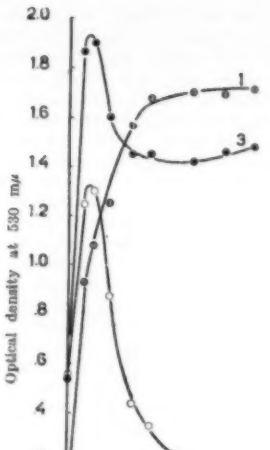
small volume. This was subjected to paper chromatography with *n*-butyl alcohol, acetic acid and water as solvent according to Partridge[7], glucose and xylose being used as reference sugars.

The photograph reproduced shows the relative positions of the sugars fixed with ammoniacal silver nitrate. A very concentrated solution of the hydrolysate was employed, so that detection of xylose would be possible even if present in small proportion. Hence α-cellulose from jute seems to be free from xylose. This was confirmed with aniline hydrogen phthalate as spraying agent[8] instead of silver nitrate in ammonia; no red spot was visible near the position of xylose.

P. B. Sarkar
A. K. Mazumdar
K. B. Pal

Technological Research Laboratories,
Indian Central Jute Committee,
Regent Park, Tollygunge,
Calcutta-33. Jan. 24.

[1] Hawley and Norman, *Indust. Eng. Chem.*, **24**, 1190 (1932).
[2] Astbury, Preston and Norman, *Nature*, **136**, 391 (1935).
[3] Norman, *Biochem. J.*, **30**, 831 (1936).
[4] Meyer, "High Polymers", **4**, 351 (Interscience Publishers, N.Y., 1942).
[5] Norman, "Biochemistry of Cellulose, Polyuronides, Lignin, etc.", 22 and 28 (Oxford University Press, 1937).
[6] Sarkar, Mazumdar and Pal, *J. Text. Inst.*, **39**, T 44 (1948).
[7] Partridge, *Biochem. J.*, **42**, 238 (1948).
[8] Partridge, *Nature*, **164**, 443 (1949).



(1) 0·0015 *M* glucosamine-HCl; (2) 0·025 *M* glucose + 0·0025 *M* lysine-2HCl; (3) 0·0015 *M* glucosamine-HCl + 0·025 *M* glucose + 0·0025 *M* lysine-2HCl

Influence of Sugars and Amines on the Colorimetric Hexosamine Method of Elson and Morgan and its Possible Elimination

During the course of investigations on the chemistry of the jelly coat of sea-urchin egg[1,2], the analyses for hexosamine by paper partition chromatography[3] were found to be negative in spite of the positive results obtained with the colorimetric method of Elson and Morgan[4]. This was found[5] to depend on an interaction of the sugars with the amino-compounds, especially lysine, of the hydrolysate, resulting in a red colour with the same absorption maximum (at 530 mμ) as for glucosamine. The interaction of mixtures of sugars and certain amino-acids, especially lysine and glycine, on the hexosamine reaction has been pointed out before (for example, refs. 5 and 6); but in these cases, where the hexosamine values were rather high compared with the interfering substances, the discrepancies were small. In our case, however, the error apparently is unusually high. Since in other biological material similar conditions may exist, we thought this communication might be of some value.

The sugar–amine reaction may be differentiated from the hexosamine reaction in a relatively simple manner. (1) The optimum *p*H for glucosamine is at 9·5[7], and for the sugar–amine mixtures at 10·8–11·2. (2) Glucosamine does not give any colour with Ehrlich's reagent[4] after being heated in sodium carbonate buffer alone, whereas the sugar–amine mixtures give a red colour (absorption maximum at 560–570 mμ) after this treatment[5]. (3) When acetylacetone is added to the sodium carbonate buffer and the *p*H is kept constant at 9·5, the colour intensity with glucosamine rises with the increase in acetylacetone concentration[7]. The sugar–amine mixtures, on the other hand, have a maximum in colour intensity at 0·7–0·8 per cent of acetylacetone in the acetylacetone reagent (that is, acetylacetone in sodium carbonate buffer) and show a rapid drop when the percentage is increased. Some results are shown in the accompanying graph and table, using the Beckmann spectrophotometer model *DU*, slit-width 0·015 mm. (see ref. 2).

*p*H	Optical density									
	9·55					10·80				
Percentage of acetylacetone in *M* carbonate–bicarbonate acetylacetone reagent	0·00		0·80	1·96	5·66	0·00		0·80	1·96	4·00
Wave-length (mμ)	570	530				570	530			
0·0015 *M* glucosamine-HCl	0·000	0·000	1·073	1·610	1·693	0·000	0·000	0·358	1·066	1·500
0·0125 *M* glucose +										
+ 0·0025 *M* lysine-2HCl	0·480	0·312	0·436	0·157	0·072	0·890	0·552	1·470	0·775	0·244
+ 0·0025 *M* ornithine-2HCl	0·310	0·303	0·935	0·374	0·158	0·860	0·620	2·000	1·925	0·732
+ 0·0025 *M* β-alanine	0·229	0·151	0·172	0·082	0·048	0·313	0·207	0·437	0·246	0·109
+ 0·0100 *M* glycine	0·094	0·068	0·292	0·132	0·067	0·133	0·095	0·610	0·366	0·138
+ 0·0025 *M* methylamine-HCl	0·512	0·347	0·395	0·187	0·106	0·890	0·570	0·957	0·576	0·213
0·0015 *M* glucosamine-HCl + 0·0125 *M* glucose +										
+ 0·0025 *M* lysine-2HCl	0·523	0·346	1·600	1·466	1·633	0·900	0·557	1·933	1·690	1·473
+ 0·0025 *M* methylamine-HCl	0·520	0·357	1·225	1·475	1·535	0·960	0·605	1·260	1·500	1·563

In view of these results, the figures given by Krauss on the glucosamine content of *Strongylocentrotus purpuratus* jelly substance are understandable. By using Kunitz's modification of the Elson and Morgan reaction (working at *p*H 10·3) he obtained 4–5 per cent glucosamine[6]; but with Palmer, Smyth and Meyer's modification (at *p*H 9·5) he found only 1·6 per cent[6]. A glucose–lysine mixture, containing these components in approximately the same proportion as in jelly hydrolysate and giving a colour intensity corresponding to 1·6 per cent glucosamine at *p*H 9·5, gives, in fact, about 5 per cent apparent glucosamine at *p*H 10·3 (see ref. 2).

The error introduced by the presence of sugars and amines differs widely with the acetylacetone concentration and the amounts of the interacting substances. The error is very high, for example, at a low percentage of acetylacetone (see graph). This deviation seems especially well suited for detecting this error. But also the difference in *p*H optimum for these reactions may be useful (see table). Curve 3 in the graph, representing the colour intensity of a mixture of glucosamine (curve 1) and glucose and lysine (curve 2), is higher than both these curves at low acetylacetone concentrations, but cuts the glucosamine curve at an acetylacetone percentage between 1 and 5 per cent, depending on the mutual concentrations of the different components. At higher acetylacetone concentrations, curve 3 is lower than the glucosamine curve, approaching it gradually, as is indicated in the graph.

J. Immers
E. Vasseur

Wenner-Gren's Institute for
Experimental Biology,
University of Stockholm.

[1] Cf., for example, Vasseur, E., *Acta Chem. Scand.*, **2**, 900 (1948); *Arkiv Kemi*, **1**, 105 (1949).
[2] Vasseur, E., and Immers, J., *Arkiv Kemi*, **1**, 253 (1949).
[3] Partridge, S. M., *Biochem. J.*, **42**, 238 (1948).
[4] Elson, L. A., and Morgan, W. T. J., *Biochem. J.*, **27**, 1824 (1933).
[5] Sideris, C. P., Young, H. Y., and Krauss, B. H., *J. Biol. Chem.*, **126**, 233 (1938).
[6] Bendich, A., and Chargaff, E., *J. Biol. Chem.*, **166**, 283 (1946).
[7] Sorensen, M., *C.R. Lab. Carlsberg, Sér. Chim.*, **22**, 487 (1938).
[8] Cf. Tyler, A., *Physiol. Rev.*, **25**, 180 (1948); *Anat Rec.*, **101**, 658 (1948).
[9] Krauss, M., *Biol. Bull.*, **96**, 74 (1949).

2.3- and 2.5-Dihydrothiophenes

The non-catalytic reduction of thiophene by sodium and methanol in liquid ammonia at −40° C. has been shown to yield a mixture of the two isomeric dihydrothiophenes (thia*cyclo*pentenes), 2-butene-1-thiol (crotyl mercaptan), normal butenes and hydrogen sulphide. The dihydrothiophenes correspond to the 1.2- and 1.4-addition of a molecule of hydrogen to the conjugated system of the thiophene, the ratio of the two products being approximately 1 : 2. The formation of the mercaptan is accounted for by the fission of the dihydrothiophene ring. This type of fission, involving the C—S linkage, has previously been observed to take place with dihydrothionaphthene[1] and some alkyl alkenyl sulphides[2] under conditions comparable with those employed by us. The presence of normal butenes and hydrogen sulphide among the products indicates that 2-butene-1-thiol is also capable of undergoing a similar fission, which was confirmed by treating the mercaptan by itself with sodium and methanol, when the same degradation products were obtained.

Compound	B.p. °C.	M.p. °C. (*a*)	M.p. for zero impurity °C. (*b*)	n_D^{25}	d^{25}	Estimated purity (mole %)
Thiophene (*c*)	84·0	−38·7	−38·2	1·5286	1·0642	99·5
2.3-Dihydrothiophene	112·0 (*d*)	−110·2	−108·7	1·5311	1·0361	97·5
2.5-Dihydrothiophene	122·3 (*e*)	−50·3	−49·3	1·5306	1·0591	98·5
Tetrahydrothiophene (thia*cyclo*pentane) (*c*)	121·2	−96·2	−96·1	1·5047	0·9998	99·7

(*a*) Melting point actually determined in these laboratories. (*b*) Calculated melting point for zero impurity. (*c*) Determined in these laboratories. (*d*) Accuracy ± 0·5° C. (*e*) Accuracy ± 0·1° C.

The physical properties of the two isomers are given in the accompanying table, which includes, for comparison, those of thiophene and tetrahydrothiophene (thia*cyclo*pentane). Melting points were determined using the procedure described by Mair, Glasgow and Rossini[3].

The only reference to dihydrothiophene occurring in the literature is to the work of Slobodin[4], who claimed that he had obtained the 2.5-dihydro-derivative by the action of sodium sulphide in aqueous alcoholic solution on 1.4-dibrom-2-butene. The physical properties of Slobodin's compound (b.p. 103–105° C., n_D^{21} 1·4814, d^{21} 0·978), together with the melting points of the mercurichloride and methiodide given, indicate, however, that it was not 2.5-dihydrothiophene but a compound of unknown constitution.

The preparation and identification of the dihydrothiophenes through their sulphones and the corresponding dibromosulphones will be described in detail in due course elsewhere.

S. F. Birch
D. T. McAllan

Research Station,
Anglo-Iranian Oil Co., Ltd.,
Sunbury-on-Thames.
Jan. 12.

[1] Fricke and Spilker, *Ber.*, **58B**, 24 and 1589 (1925).
[2] Farmer and Shipley, *J. Chem. Soc.*, 1519 (1947).
[3] Mair, Glasgow and Rossini, *J. Res. Nat. Bur. Stand.*, **26**, 591 (1941).
[4] Slobodin, *J. Gen. Chem.* (*U.S.S.R.*), **8**, 714 (1938).

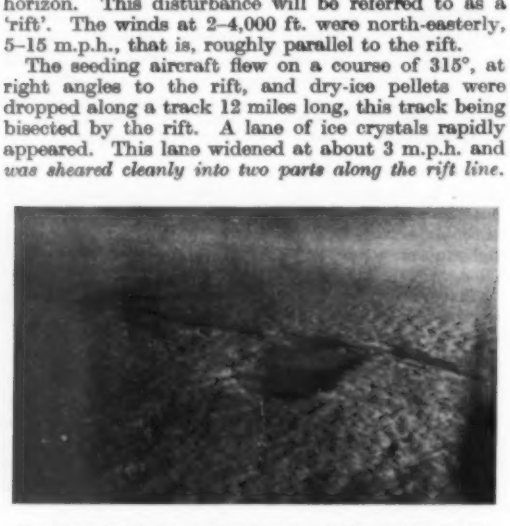
Details of Wind Structure Revealed by Artificial Nucleation of Supercooled Clouds

When 'dry-ice' pellets, or other suitable nucleation agents, are introduced into a cloud of supercooled water droplets, large numbers of ice crystals are formed[1]. These ice crystals grow at the expense of the water droplets and are generally precipitated.

With cloud of sheet type, which is cold enough and not too deep, this precipitation often leads to the appearance of a cleared lane—or, at any rate, a lane in which there are only ice crystals—which steadily increases in size. The amount of precipitation is almost always trivial; but the manner, and the rate, of the growth of the infected lane provides information about the turbulent processes, probably modified by the experiment, at work within the cloud. Moreover, observations of the movement and behaviour of the lane as a whole provide information, with detail scarcely otherwise obtainable, of the wind structure inside the cloud.

On January 25, 1950, a suitable cloud sheet covered most of southern England. The cloud was some 2,000 ft. deep, with top at about 4,500 ft. Temperatures within the cloud ranged from −5° to −10° C. Over East Anglia the upper surface of the cloud, otherwise fairly uniform, was disturbed along a line running roughly north-east from somewhere near Shefford, out to a large clear area visible on the horizon. This disturbance will be referred to as a 'rift'. The winds at 2–4,000 ft. were north-easterly, 5–15 m.p.h., that is, roughly parallel to the rift.

The seeding aircraft flew on a course of 315°, at right angles to the rift, and dry-ice pellets were dropped along a track 12 miles long, this track being bisected by the rift. A lane of ice crystals rapidly appeared. This lane widened at about 3 m.p.h. and *was sheared cleanly into two parts along the rift line.*



The whole infected area after 30 min., looking east-south-east

The accompanying photograph, taken thirty minutes after seeding, shows the rift running from lower right to centre left. The two halves of the infected area are now each about six miles long (at right angles to the rift) and about 1½ miles wide; and are about five miles apart.

The experiment thus reveals the existence of a horizontal wind shear of the order of 10 m.p.h. across a rift which was, before the seeding, less than a quarter of a mile wide. This is probably the first evidence that strong wind shear can occur at heights well above the ground, and in apparently non-frontal conditions. A full report is to be published elsewhere.

Acknowledgment is due to the Director of the Meteorological Office for permission to publish this note; and to the members of the Meteorological Research Flight who conducted the experiment.

RONALD FRITH

Meteorological Research Flight,
Royal Aircraft Establishment,
Farnborough.
March 13.

[1] See, for example, Schaefer, *Science*, **104**, No. 2707 (1946).

Breaking of Diapause in the Winter Egg of the European Red Spider

ON the strength of the results obtained by Slifer[1], which prove that it is possible to influence the development of grasshopper eggs by treatment with a wax-solvent agent, a similar experiment has been made to investigate the possibility of breaking the diapause in winter eggs of the European red spider (*Metatetranychus ulmi* Koch).

Small pieces of apple twigs with winter eggs on them were collected in the orchard just before treatment. They were dipped into xylene for a certain time, while being gently shaken; the twigs were then glued on a glass slide surrounded by a ring of sticky material and stored at 20° C. and 95 per cent relative humidity above a saturated solution of sodium sulphite for the incubation of the eggs. At certain intervals the hatched spiders, caught in the sticky band, were counted and removed from the slides.

Eggs collected on November 30, whether dipped or untreated, hatched during two distinct periods of time, namely, from 9 to 22 days later and from 40 to 80 days later. Approximately 10 per cent of the untreated eggs hatched in the first period. Dipping for five minutes had no effect; but longer treatment increased the proportion of eggs hatching in the first period, depending on the treatment-time as shown in the accompanying table.

Length of dipping time	% viable eggs hatched during 1st period	2nd period
No treatment	about 10	90
5 min.	,, 10	90
10 ,,	,, 25	75
20 ,,	,, 85	15

If the eggs were collected at a later date, the same results were obtained except that the time between the two hatching periods decreased until, with eggs collected in February, both treated and untreated eggs readily hatched after incubation for only ten days.

The breaking of diapause at an earlier date and the influence of different degrees of humidity are being investigated.

G. F. E. M. DIERICK

Koninklijke/Shell-Laboratorium,
Amsterdam.
Jan. 13.

[1] Slifer, E. H., *J. Exp. Zool.*, **102**, 333 (1946).

Copper-Deficiency Disease of Apple Trees

THE communication by Mr. J. O. Jones[1] dealing with the copper-deficiency disease of pear trees has tempted me to write briefly of my experience of the summer-spraying of apple trees in Northern Ireland with Bordeaux mixture. In the early nineteen-twenties, the 6,000 acres of apple orchards in the north of County Armagh and the south of County Antrim, which are mainly planted with the variety Bramley's Seedling, were in a very poor condition. The position was so serious that unless something could be done to restore the health of the trees, it looked as if the apple crop might become entirely unprofitable. Except for occasional winter-spraying with lime or caustic soda (tar-oil washes had only just been introduced) and the application of lead arsenate in summer to control caterpillar attack, no regular spraying programme was in operation and no suitable spraying machinery was available. Apple scab (*Venturia inaequalis* Aderh.) had just commenced to attack the variety Bramley's Seedling, and it was obvious that the control of this disease presented a major problem.

Experimental work was commenced in 1924 and, in the main, was framed with the view of determining

to what extent apple scab could be controlled by thorough summer-spraying with Bordeaux mixture or lime sulphur. The results obtained were surprising. Lime sulphur was found to be generally unsuitable for use with Bramley's Seedling in Northern Ireland; but even when it was used at such a strength and under such conditions as to cause no appreciable phytotoxic effect, the results were disappointing. It proved to be almost as effective for the control of apple scab as Bordeaux mixture, but there the similarity ceased. Trees sprayed with weak Bordeaux mixture (5; 15; 100) seemed to take on a fresh lease of life. They burst into fresh and vigorous growth, produced large dark-green healthy leaves, and yielded nine times the weight of fruit borne by the controls[2].

These results were obtained in general over the whole area and from experiments conducted over a number of years; the effect of spraying also tended to be cumulative. In time, the trees sprayed with Bordeaux mixture overshadowed the controls and those sprayed with lime sulphur, and presented a picture of robust growth and vigour which was, to say the least, outstanding. They blossomed earlier, producing a greater quantity of stronger bloom, and those applications of spray made before the blossom reached the 'pinking' stage were found to be particularly advantageous. It is not suggested that Bordeaux mixture is a kindly fungicide for use with apple trees, but the results obtained by its use were such as to outweigh any disadvantages such as the slight scorching of the fruit. This damage was greatly reduced by using an excess-lime mixture. By 1930 the spraying of apple orchards in accordance with these findings had become general practice and the crop had become profitable. Fruit to the annual value of about £1,000,000 was produced from this orchard belt during the Second World War.

Apple scab had become epidemic in these orchards by the early nineteen-twenties and, undoubtedly, excellent results have been obtained by its control; but I have always been of the opinion that the control of this disease did not represent the whole of the story, as is evident by the following quotation from the published account of the work[2]: "the reason for this large increase [of crop] is at present not clear, but it is hoped that further work will shed more light on the problem". At that time, crop diseases due to deficiencies of trace elements were only beginning to receive recognition, and facilities for thoroughly investigating the problem were not readily available. Apart from the anatomical examination of leaves from sprayed and unsprayed trees—the difference was so marked—no further experimental work was undertaken; but I have always believed that an important factor in restoring the health of Northern Ireland orchards by spraying with Bordeaux mixture has been the correction of a deficiency of copper. If this is so—and the supporting evidence is very strong—then the correction of a copper-deficiency disease of apple trees by spraying with Bordeaux mixture has been generally practised in Northern Ireland for the past twenty years.

A. E. Muskett

Plant Pathology Division,
Ministry of Agriculture, N.I.,
Queen's University,
Belfast.
March 18.

[1] Jones, J. O., *Nature*, **165**, 192 (1950).
[2] Muskett, A. E., and Turner, E., *J. Min. Agric. N.I.*, **2**, 26 (1929).

Soil and Vegetation in British Somaliland

I have read with interest and grave misgivings Dr. W. A. Macfadyen's short communication in *Nature* of January 21, p. 121, and can only conclude that he had misinterpreted the two factors which he claims have been generally overlooked.

There is conclusive evidence that the soils of British Somaliland are in the process of severe erosion as a consequence of drastic overgrazing and cutting of branches of a great number of species of trees as fodder when herbaceous pastorage has become depleted. Extensive forests of dead trees are to be found in many parts of the Protectorate, of which the Sawl Haud is one, and, in the highlands, live trees may frequently be found with their roots exposed as much as 3 ft. above the ground.

I have not the slightest doubt that Jacks and Whyte are entirely right in their interpretation of the aerial photograph which they correctly entitled "wind erosion". Again, there is conclusive evidence of wind erosion throughout the territory, and the "vegetation arcs" referred to by Dr. Macfadyen are, in fact, ripples of sand piled up by the strong Khareef wind which blows almost incessantly for several months of the year. In the height of the Khareef season dust particles in the air are so numerous that the sun is obscured even at midday. What, in fact, does happen is that seeds are blown on to the sand ripples, where they germinate during the rains. Dr. Macfadyen is right when he claims that the "vegetation arcs" roughly approximate to naturally marked contours. They do, and act as contour terraces which hold up rain water in the country of low relief where they occur. The "surprising abundance of excreta deposited rhythmically in convex strand lines" is but another proof of the excessive numbers of stock to be found in Somaliland.

The reason why the areas between the wind ripples or "vegetation arcs" are almost completely bare is due to three facts: (1) grazing animals tend to concentrate between these "vegetation arcs" and in so doing denude the ground of its plant cover; (2) these animals trample and pulverize the soil surface, which is afterwards blown away, leaving a hard compacted layer which inhibits plant growth; and (3) in many cases so much of the upper soil has been blown away that either rock has become exposed or only a shallow layer of soil remains, which again is not conducive to healthy plant-growth.

Random counts of the more important trees were made in twenty-three different parts of the territory, and of a total of 17,199 trees counted in this way, 6,024 (35 per cent) were dead, 4,982 (29 per cent) had their branches lopped, 294 (2 per cent) had their bark stripped off, 3,756 (22 per cent) were undamaged and 2,143 (13 per cent) were young plants less than 45 cm. high; but of these, 1,172 were seedlings of *Juniperus* counted at Gaan Libah. Out of a total of 15,145 trees counted in the other parts of the country only 971 (6 per cent) were young plants and 5,892 (38 per cent) were dead. This means that the mortality-rate of the important British Somaliland trees is more than six times as great as the regeneration-rate in all the areas in which counts were made, except one. It is difficult to understand, in face of these facts, how the vegetation could be recovering after Pleistocene denudation.

P. E. Glover

P.O. Box 2141,
Nairobi, Kenya.
March 16.

FORTHCOMING EVENTS

*(Meeting marked with an asterisk * is open to the public)*

Monday, June 5

BRITISH SOCIETY FOR THE HISTORY OF SCIENCE (in the Lecture Room, Science Museum, Exhibition Road, London, S.W.7), at 5.30 p.m.—Scientific Papers.

UNIVERSITY OF LONDON (in the Assembly Hall, Institute of Education, Malet Street, London, W.C.1), at 5.30 p.m.—Prof. Philip Ewart Vernon: "Modern Educational Psychology as a Science" (Inaugural Lecture).*

CHEMICAL SOCIETY, OXFORD SECTION (in the Physical Chemistry Laboratory, Oxford), at 8.15 p.m.—Prof. W. E. Garner, F.R.S.: "Catalysis on Oxides" (Alembic Club Lecture). (All Fellows are invited.)

ROYAL GEOGRAPHICAL SOCIETY (at 1 Kensington Gore, London, S.W.7), at 8.15 p.m.—Prof. Dillon Ripley: "United States Expedition to Nepal".

Tuesday, June 6

BONE AND TOOTH SOCIETY (at the Institute of Orthopædics, 234 Great Portland Street, London, W.1), at 5 p.m.—Symposium on "Bone Structure".

ROYAL ANTHROPOLOGICAL INSTITUTE (in the Embryology Theatre, University College, Gower Street, London, W.C.1), at 5 p.m.—Dr. A. N. Tucker: "Recording African Music without a Recorder".

Tuesday, June 6—Friday, June 9

INSTITUTION OF GAS ENGINEERS (at the Winter Gardens, Bournemouth).—87th Annual General Meeting.

TEXTILE INSTITUTE (at the Town Hall, Cheltenham).—Annual Conference.

Wednesday, June 7

ROYAL SOCIETY OF MEDICINE, HISTORY OF MEDICINE SECTION (at 1 Wimpole Street, London, W.1), at 4.30 p.m.—Prof. Henry E. Sigerist: "The Need for Re-writing the History of Medicine".

GEOLOGICAL SOCIETY OF LONDON (at Burlington House, Piccadilly, London, W.1), at 5 p.m.—Scientific Papers.

Thursday, June 8

ROYAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Scientific Papers.

MINERALOGICAL SOCIETY (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 5 p.m.—Scientific Papers.

Friday, June 9

BRITISH MYCOLOGICAL SOCIETY (at the Experimental and Research Station, Cheshunt, Herts), at 11.30 a.m.—Twenty-fourth Annual Plant Pathology Field Day.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

ASSISTANT LECTURER IN INDUSTRIAL METALLURGY—The Secretary, The University, Birmingham 3 (June 10).

LECTURER IN (heavy and light) ELECTRICAL ENGINEERING, LECTURERS (2) IN PHYSICS, and a LECTURER IN CHEMISTRY (Inorganic and Metallurgy)—The Principal, Paisley Technical College, George Street, Paisley (June 10).

LECTURER IN GEOGRAPHY in the United College, St. Andrews—The Secretary, The University, St. Andrews (June 10).

ASSISTANT LECTURERS or LECTURERS IN THE DEPARTMENT OF PHYSICS—The Secretary, University College, Gower Street, London, W.C.1 (June 15).

ASSISTANT AGRICULTURAL ECONOMIST (with a university degree in economics and/or agriculture)—The Registrar, The University, Bristol 8 (June 17).

ASSISTANT BACTERIOLOGIST IN THE WATER EXAMINATION DEPARTMENT—The Clerk of the Metropolitan Water Board, New River Head, Rosebery Avenue, London, E.C.1, endorsed 'Assistant Bacteriologist' (June 17).

LECTURER IN THE DEPARTMENT OF ENGINEERING—The Secretary, The University, Edinburgh (June 17).

EXPERIMENTAL OFFICERS (unestablished) at the National Physical Laboratory for work in (*a*) metallurgical analysis, (*b*) metallurgical literature, especially French and German, (*c*) high temperature physical chemistry, (*d*) X-ray crystallography and electron microscopy, (*e*) standard weighing machines, (*f*) photometry, absorptiometry or colorimetry, (*g*) creep and fatigue of metals—The Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, London, W.C.2, quoting F.313/50A (June 19).

LECTURER or SENIOR LECTURER IN THE DEPARTMENT OF HUMAN ANATOMY, University College of the West Indies—The Secretary, Senate Committee on Higher Education in the Colonies, University of London, Senate House, London, W.C.1 (June 24).

SENIOR RESEARCH OFFICER or RESEARCH OFFICER, Biochemistry Unit, Wool Textile Research Laboratory, Melbourne—The Chief Scientific Liaison Officer, Australian Scientific Liaison Office, Africa House, Kingsway, London, W.C.2, quoting No. 2856 (June 24).

MAY AND BAKER RESEARCH FELLOWSHIP for research on plant growth regulating substances—The Registrar, Wye College, Wye, Ashford, Kent (June 30).

ASSISTANT LECTURER IN PHYSICS—The Dean, Medical School, Guy's Hospital, London, S.E.1 (July 1).

SENIOR LECTURER IN ZOOLOGY with special qualifications in Marine Biology, at the University College of the Gold Coast—The Secretary, Inter-University Council for Higher Education in the Colonies, 1 Gordon Square, London, W.C.1 (July 8).

LECTURER or ASSISTANT LECTURER IN THE DEPARTMENT OF TEXTILE INDUSTRIES—The Registrar, College of Technology, Manchester 1 (July 10).

PROFESSOR OF PHYSICS, a PROFESSOR OF BOTANY, and a READER IN GEOLOGY—The Registrar, University of Dacca, P.O. Ramna, East Bengal, Pakistan (July 31).

ASSISTANT MECHANICAL ENGINEERS (2) in the Sudan Irrigation Department—The Sudan Agent in London, Wellington House, Buckingham Gate, London, S.W.1, endorsed 'Sudan Irrigation (Mechanical)'.

BRADFORD DYERS' ASSOCIATION FELLOWSHIP for research in tinctorial chemistry, textile chemistry, or an allied subject—The Principal, Technical College, Bradford.

ENGINEER, PHYSICIST, or ZOOLOGIST with appropriate aptitudes (Scientific Officer or Senior Scientific Officer grade) for an operational research study to provide a rational basis for choice and design of insecticide machinery for varied circumstances and on other aspects of mechanization of locust control—The Director, Anti-Locust Research Centre, British Museum (Natural History), Cromwell Road, London, S.W.7.

HEAD OF THE DEPARTMENT OF PHYSIOLOGY and a SENIOR ASSISTANT—The Clerk to the Governors, Chelsea Polytechnic, Manresa Road, London, S.W.3.

LECTURER IN MATHEMATICS—The Principal, Sir John Cass College, Jewry Street, London, E.C.3.

MATHEMATICS INSPECTOR to take charge of Mathematics at the Institute of Education, Sudan—The Sudan Agent in London, Wellington House, Buckingham Gate, London, S.W.1, endorsed 'Mathematics Inspector'.

PROFESSOR OF AUTOMOBILE ENGINEERING, a PROFESSOR OF AERONAUTICAL ENGINEERING, and a PROFESSOR OF INSTRUMENT TECHNOLOGY—The Principal, Madras Institute of Technology, Chromepet P.O., Chingleput Dist., Madras, India.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

British Journal of Sociology. (Quarterly.) Vol. 1, No. 1, March. Pp. ii+92. (London: Routledge and Kegan Paul, Ltd., 1950.) 10*s.* net; annual subscription, 30*s.* [133

Department of Agriculture: Fisheries Branch. Statistics of Salmon, Sea Trout and Eels captured during each of the Years 1948, 1947, 1946, 1945, 1943, 1941. (P. No. 9627.) Pp. 18. (Dublin: Stationery Office, 1949.) 6*d.* [133

Philosophical Transactions of the Royal Society of London, Series B: Biological Sciences. No. 610, Vol. 234: Competition for Food and Allied Phenomena in Sheep-Blowfly Populations. By G. C. Ullyett. Pp. 77–174. (London: Cambridge University Press, 1950.) 22*s.* [143

Census of England and Wales, 1931. General Report. Pp. viii+197. (London: H.M. Stationery Office, 1950.) 10*s.* net. [143

Pest Control Farmers' Handbook. Compiled by Dr. W. E. Ripper, A. L. Abel, Dr. R. M. Greenslade, S. G. Gray, F. R. Petherbridge and R. W. Shorrock. Pp. 100. (Cambridge: Pest Control, Ltd., 1950.) [143

University of Reading: National Institute for Research in Dairying. Report for the Year ended 30th September 1948. Pp. 72. (Reading: National Institute for Research in Dairying, 1949.) [143

Other Countries

Nigeria. Annual Report on the Agricultural Department for the Year 1948. Pp. 75. (Lagos: Government Printer; London: Crown Agents for the Colonies, 1949.) 9*d.* net. [133

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 101, 1949. Pp. iv+349. (Philadelphia: Academy of Natural Sciences, 1949.) 7.50 dollars. [133

Bulletin of the Museum of Comparative Zoology at Harvard College. Vol. 103, No. 3: The Salticid Spiders of Jamaica. By Elizabeth B. Bryant. Pp. 161–209+3 plates. (Cambridge, Mass.: Harvard College, 1950.) [133

Bulletin of the American Museum of Natural History. Vol. 94, Art. 6: The Genus *Cheilosia* Meigen (Diptera, Syrphidae); the Subgenera *Cheilosia* and *Histomyia*. By Frank Montgomery Hull and Charles Lewis Fluke, Jr. Pp. 299–402. (New York: American Museum of Natural History, 1950.) 1.25 dollars. [133

British Honduras. Report of the Forest Department for the Year ended 31st December 1948. Pp. 30. (Belize: Government Printer, 1949.) [133

Joint Committee on Rheology of the International Council of Scientific Unions. Report on the Principles of Rheological Nomenclature. By J. M. Burgers and G. W. Scott Blair. Pp. ii+72. (Amsterdam: North-Holland Publishing Co., 1949.) 2.50 f. [133

Catalogues

Reference Books for the Technical Man. Pp. 8. (Brooklyn, N.Y.: Chemical Publishing Co., Inc., 1950.)

Rohm and Haas Reporter. Vol. 7, No. 6, December 1949. Pp. 22. (Philadelphia: Rohm and Haas Company, 1949.)

A Selection of Interesting Books on a Great Variety of Subjects. (No. 676.) Pp. 100. (London: Bernard Quaritch, Ltd., 1950.)

Medical Books, with a Section on the Spas of Europe. (No. 138.) Pp. 36. (London: Ifan Kyrle Fletcher, 12 Lansdowne Road, S.W.20, 1950.)

Reference Books and Bibliographies. Pp. 80. (New York: Herbert Reichner, 1950.)